1988
TELECOMMUNICATIONS MARKET REVIEW

Annual Report of the Telecommunications Industry

North American Telecommunications Association

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Telecommunications Industry

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SCOPE AND METHODOLOGY

The 1988 Telecommunications Market Review was prepared by the Market Research Department of the North American Telecommunications Association. The information contained in the report was obtained through primary and secondary research methods. The primary research involved the collection of data from manufacturers and distributors of business telecommunications systems. This was supplemented with data from U.S. Government Sources, principally, the Federal Communications Commission, the U.S. Department of Commerce, and the Bureau of Labor Statistics. Other industry data was derived by reviewing all relavent trade journals and other public sources and preparing estimates that present the general concensus of industry trends. The information contained in this report represents the best efforts of the NATA Market Research Department at preparing useful and timely marketing information on a wide variey of industry segments. NATA specifically does not guarantee the accuracy of the data contained in this report. NATA staff is available to answer any questions relating to the statistics presented herein by calling 1-800-LET-NATA.

THE YEAR IN REVIEW

By Edwin B. Spievack, President, NATA

The year 1987 was filled with both opportunity and uncertainty for the industry. Mergers and aquisitions ocurred in every sector. Mature markets witnessed sluggish demand and diminishing profit margins, while nascent markets exploded and margins were covetous. The integration of computer and telecommunications technology accelerated, with the market for data communications equipment becoming one of the hottest sectors of the industry. And with that joint marketing trend, attention to superior customer service, broadening product offerings to include data equipment, voice peripherals, and telecom services--in short, the trend toward systems integration--positioned industry leaders on the path to increased profitibility.

This year, 1988, marked the 20th anniversary of the Carterfone decision, the landmark ruling that set the tone for competition in the industry. As such, we commemorate the daring entrepreneurs that shaped the telecommunications industry into a truly competitive marketplace where more opportunities are available to more companies and where consumers are offered a myriad of products and services that make communications more efficient, advanced and manageable.

Overall, the total market for all telecommunications equipment expanded by 4 percent from $27.4 billion in 1986 to $28.5 billion in 1987. The largest sector, central office switches, amounted to $5.0 billion in 1987, down slightly from 1986. The market for facsimile equipment was the fastest growing of the segments, soaring over 100 percent from $260 million in 1986 to $539 million in 1987. Other growth markets included call/voice handling equipment, such as voice mail and automatic call distributors, which increased by 50 percent from $565 million in 1986 to $850 million in 1987.

The past few years have witnessed intense competition in the telecommunications arena. The industry's market opening efforts have allowed all producers to compete for a share of the market. Foreign producers are taking advantage of the opportunities and are increasing their presence in the U.S. telecommunications marketplace, increasing their share of the market from 17 percent in 1984 to 20 percent in 1987. In absolute terms, U.S. imports of telecommunications equipment increased from $3.5 billion to $5.6 billion during the time period. The largest source throughout the period was East Asia. In 1987, imports from that region amounted to $4.3 billion. Shipments from Japan, the largest East Asian supplier amounted to $2.4 billion in 1987. Increases from other Far Eastern countries such as South Korea, Hong Kong, Singapore, and Taiwan were due, in part to U.S. and Japanese companies setting up facilities in those countries to take advantage of low wage rates, government incentives, and favorable exchange rates. Products from those countries tend to be low-end, price sensitive, and consumer-oriented.

Despite the growth in U.S. exports of telecommunications equipment from $2.3 billion in 1984 to $2.5 billion in 1987, the trade deficit continues to grow, from $1.2 billion in 1984 to $2.5 billion in 1987. U.S. companies are faced with many obstacles in trying to export. Many foreign markets are virtually closed to competition due to the monopolistic purchasing environment where indigenous suppliers are given preference. There has been some progress recently, with some countries beginning to open, at least part of their markets. However, much work needs to be done to make opportunites abroad for U.S. companies as fruitful as they are in the U.S. for foreign producers.

Public policy developments in the past year have covered a potpourri of issues and have produced mixed results in terms of NATA's long standing efforts to ensure a procompetitive playing field. The MFJ court completed its first triennial review, keeping many of the significant safeguards intact. However, the RBOCs were allowed to begin offering "gateway" services and voice-messaging. These will likely have far-reaching consequences on those industries.

Congress also has been active in telecommunications. Most of what it has done has not been particularly encouraging. The Omnibus Trade Bill passed this year, which has strong language favoring relatiatory trade measures. If the execution of the law is pursued with significant vigor, the results may be trade disputes that might stifle competition in the U.S. telecom market. In addition, a nonbinding resolution to "Free the Bells" was introduced. This

makes the competitive telecommunications industry shake in its boots. Although the resolution would not have any effect as law, it could set the stage for a move back in time to an anticompetitive, vertically integrated monopolistic marketplace.

The FCC has been somewhat more favorable. The Commission has pursued the enforcement of the sales agency program, ensuring that nontelcos have the same marketing capabilites as telcos and receive commissions for their sales of network services. In the area of customer proprietary network information (CPNI), the Commission sided with NATA. Other procompetitive efforts included decisions on comparably efficient interconnection (CEI) and open network architecture (ONA).

The past year has been exciting, exasperating, explosive and anemic. Some companies in the competitive telecommunications industry have done extremely well, others barely survived and others didn't make it. Overall, telecommunications remains a good business. It is one of the most critical aspects of conducting business. More efficient telecommunications systems mean better business efficiency, which means better margins. The telecommunications company that can produce and creatively market a solution to a customers business telecommunications needs will, like the producer of the proverbial better mousetrap, "have the world beating a path to its door."

OVERVIEW OF CONTENTS

The following chapters and appendices provide information and analysis relating to the market conditions of selected aspects of the telecommunications industry. The report is divided into six chapters. Each section of each chapter is formatted with a descriptive analysis followed by various associated figures and tables. At the end of the report are four appendices to assist the reader. In general, in this report, the telecommunications industry is defined along the lines of the Standard Industrial Classification (SIC) nomenclature. The telecommunications equipment industry is considered to include all of SIC 3661, Telephone and Telegraph Equipment; and part of SIC 3662, Radio Communication and Detection Equipment. Telecommunication services are defined as SIC 4811, Telephone Communications and SIC 4821, Telegraph and Other Message Communications. Where government data is presented on domestic activity, the data has been obtained in terms of those classifications. The foreign trade data is collected in terms of other nomenclature (Tariff Schedules of the United States (TSUS) for Imports and Schedule B for exports), but in total, they represent the same coverage as the SIC industries listed.

Chapter I. Executive Summary–This chapter presents a broad-brush look at the telecommunications industry with sections on customer premises equipment, network equipment, and services. General trends in overall growth and market potential are explored.

Chapter II. Overview of Equipment Markets–In this chapter, a brief descriptive analysis is provided on some of the largest and hottest equipment markets. This section is intended to give the reader important market information and insight at a glance. Data in this chapter comes from several industry and government sources as well as from the NATA Market Research Department.

Chapter III. U.S. Telecommunications Equipment Manufacturing Industry--This chapter analyzes the performance of the the U.S. industry that produces telecommunications equipment. Several indicators are discussed in determining the relative health of the industry. Much of the data in this chapter is from government sources.

Chapter IV. Foreign Trade–The U.S. balance of trade is presented in this chapter, along with a discussion of the international trade environment in telecommunications equipment. The data presented in this chapter comes from government sources.

Chapter V. Telecommunications Services–The information in this chapter outlines the dynamics of the telecommunications services. market with discussions of the local exchange market, interexchange market, and information services market. The data presented in this chapter is derived mostly from government sources.

Chapter VI. Selected Markets–This chapter analyzes, in detail, various important segments of the overall U.S. telecommunications market. In each section, the product is introduced and defined. This is followed by a description of the trends in the marketplace. Most of the data in this chapter comes from the NATA Market Research Department, either through primary or secondary research methods.

Appendix A. Public Policy Overview–This appendix analyzes developments of the past year in the legislative, executive, and regulatory arenas that have impacted the telecommunications industry.

Appendix B. Macroeconomic Perspective–This appendix is an excerpt from the National Telecommunications and Information Administration Report, *TELECOM 2000.* This appendix discusses the telecommunications industry from the perspective of the overall economy.

Appendix C. Contacts for Data Users–This appendix is a list of sources, primarily government, of data that were used in this report.

Appendix D. Glossary–This appendix presents an exhaustive glossary of telecommunications terms and acronyms.

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CHAPTER I

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EXECUTIVE SUMMARY

INDUSTRY OVERVIEW

The telecommunications network consists of 23,000 central office switches, more than a billion miles of transmission lines, almost as many miles of special service circuits, and 119 million access lines connecting customers to the public-switched telephone network. The U.S. market for telecommunications equipment and services is the largest and most diverse telecommunications market in the world.

The total U.S. market for telecommunications equipment grew by 11 percent per year from about $20.9 billion in 1984 to more than $28.5 billion in 1987. The market is being spurred by rapidly-evolving technology. Satellite and data communications systems, cellular mobile radio systems, and fiber optic transmission systems are being integrated into the conventional voice network, which is increasingly being converted from analog to digital systems. Most of the conversion has taken place in the transmission of signals between switches, thus vastly expanding the capacity of the network for the increasing demands placed on it. One of the most significant future uses of the increasing capacity is the rapidly evolving, completely digital, Integrated Services Digital Network (ISDN). ISDN will combine voice, data, and video into one network and will eventually likely replace the entire network giving users tremendous flexibility in communications.

Deregulation of the industry and the 1984 divestiture of AT&T encouraged domestic and foreign competition in all equipment sectors. This has lead to increasing penetration by foreign firms in the U.S. market. Approximately 20 percent of the total U.S. telecommunications equipment market is supplied by imports; up from 17 percent in 1984. Although the U.S.-based telecommunications equipment industry, as a whole, is expanding, not all firms or sectors within the industry will survive. Acquisitons and mergers are commonplace in all sectors of the telecommunications industry--equipment and service. As an example, in the first nine months of 1988, therewere at least 75 mergers or acquisitions in the industry. Distributors were key objects of the acquisition trend, as manufacturers and carriers sought to secure stable outlets for their products.

One of the most important developments in the industry is the increased importance of data communications, that has led telecommunications and computer companies to join efforts in developing new network architecture. Data communications represents the overlap between data processing and traditional communications. As the technologies of the two industries have merged, so have their applications. The tremendous growth in distributed processing and computers in general, has caused the data communications market to grow rapidly at an annual growth rate of 14 percent from $3.2 billion in 1984 to more than $4.8 billion in 1987.

CUSTOMER PREMISES EQUIPMENT

The consumer telecommunications equipment market (principally telephones and telephone answering machines) increased by an average annual rate of 13 percent from 1984 to 1987, but is expected to flatten and grow at about 4 percent a year from $2.9 billion in 1988 to $3.2 billion in 1990, as demand has become relatively saturated and prices remain stable. Sales of answering machines exhibited the strongest growth increasing by an average annual rate of 23 percent from $298 million in 1984 to $438 million in 1987.

The business telecommunications equipment market exhibited strong growth during 1984-87, due in part to exploding sales of facsimile equipment (from $175 million in 1984 to $539 million in 1987), voice messaging equipment ($5 million in 1984 to $850 million in 1987) and other add-on peripherals such as automatic call distributors, call accounting equipment, and automated attendants. Much of the growth has been due to interconnect companies diversifying their product offerings away from mature products with slim profit margins to newer products with meatier margins. U.S. sales of PBXs remained relatively flat throughout the period growing only by some 2.3 percent per year from $2.8 billion in 1984 to $3.1 billion in 1987. Sales of key systems actually declined slightly from $1.0 billion in 1984 to $960 million in 1987.

U.S. sales of PBX and key systems are influenced by factors such as the revitalization of Centrex ser-

vices by the telephone companies (a service that competes in functionality with PBX's), replacement cycles, and the progression towards ISDN. These forces have kept the demand for these products in check.

NETWORK EQUIPMENT

The U.S. market for network equipment consists of purchases by telephone companies and by other companies for private networks. The total market for such equipment increased from $8.0 billion in 1987 to $10.0 billion in 1988, due in part to the increasing popularity of cellular telephone systems (mobile radiotelephone systems). Annual capital expenditures of cellular common carrier equipment increased from $234 million in 1984 to $526 million in 1987 or by about 30 percent per year. The market for cellular equipment began in 1984 when the FCC began to authorize cellular radio communications.

The market for Central Office (CO) switches increased irregularly at an annual rate of 20 percent from $2.9 billion in 1984 to slightly more than $5.1 billion in 1987. The market for CO switches is projected to remain stable throughout the remainder of the decade. As ISDN begins to become a reality in the early 1990's, sales of digital CO switches will likely accelerate. Digital CO switches can compete successfully with PBXs in offering such advanced features as voice mail, speed calling, conferencing, call forwarding, call waiting, and CO-based local area networks.

Another important growth segment of the network equipment market is fiber optics. The market for fiber optics in the United States increased from $410 million in 1984 to $1.0 billion in 1987, or by an annual growth rate of 35 percent. The market for fiber optics cables has been stimulated by purchases of long distance telephone companies attempting to compete in such a price sensitive market. Fiber optic networks have much higher capacity than conventional cable, thus offering much lower marginal costs per long-distance conversation. In addition, local telephone companies have begun to replace local telephone loops with fiber optics. This is to foster their enhanced services offerings as well as to prepare for ISDN which will require tremendous transmission capacity.

TELECOMMUNICATIONS SERVICES

The U.S. telecommunications network links telecommunications and computer equipment for voice, text, data, and video transmission. About 85 percent of traffic on the domestic public network is voice, data accounts for roughly 10 percent, and video and other specialized services account for the remainder. Currently about 430 billion calls are placed each year over the public network. On average, each person makes almost 2,000 calls a year, or almost 5 [illegible] day. Business accounts for around 20 percent of long-distance domestic telephone use; residential users account for 71 percent; government and specializied users make up the rest. There are more than 220 million telephones in use in the United States with about 93 percent of all households having telephone service.

There are currently more than 119 million access lines in the United States--70 percent dedicated to residential use, 28 percent for business use, and the balance for specialized use.

The principal providers of telecommunication services are common carriers. This group includes local and long-distance telephone companies. The local telephone companies are comprised of two general groups--companies that were spun off by the divestiture of AT&T (RBOCs) and independent telephone companies. The local telephone companies had total revenues from all sources of approximately $101 billion in 1987, up somewhat from 1986, while long distance carriers had revenues in 1987 of some $45 billion.

The traditional telecommunications services business is no longer limited to basic telephone and telegraph service. Because of the convergence of voice and data in both technology and market structure, the industry now provides such services as computerized data transmission, electronic mail, videotex, database access, local Centrex service, software-defined "virtual" networks, "800" service, teleconferencing, facsimile, voice messaging and other voice processing, call forwarding, call screening, environment control, and control of security devices.

CHAPTER II

OVERVIEW OF U.S. EQUIPMENT MARKETS

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OVERVIEW OF U.S. EQUIPMENT MARKETS

The total market for telecommunications equipment in the United States increased steadily from $20.9 billion in 1984 to $28.5 billion in 1987, and is expected to increase to $33.8 billion by 1990 (see Fig. 1). Table 1 reveals the dollar value of selected segments of the telecommunications marketplace.

The single largest segment of the market is central office (CO) switches. The market for CO switches increased from $2.9 billion in 1984 to $5.5 billion in 1986 before decreasing somewhat to $5.1 billion in 1987. The decrease in sales of CO switches in 1987 and the continued flatness of the market that is expected over the next couple of years is due to the fact that the local exchange companies have significant quantities of analog switches that need to be fully depreciated before they will buy digital switches. As the Integrated Services Digital Network (ISDN), a digital "pipeline" for voice, data, and video services, becomes implemented in the mid-1990s, the market for CO switches should pick up as conversion to digital switches will become necessary.

The market for private branch exchanges (PBX) increased somewhat from $2.8 billion in 1984 to $3.1 billion in 1986 before turning flat in 1987 at $3.0 billion. It is expected to be flat for the next several years and amount to $3.2 billion by 1990. The reason for the flatness of the market is related to several factors. Companies that install PBXs for features such as call forwarding, transfer, group calls, etc. can get those features from a CO provided service called Centrex. In addition, due to intense competition in the PBX marketplace, prices have been flat to down over the past couple of years. Also, the PBX market is somewhat cyclical with the average PBX life cycle of seven years. The next upswing of the market should begin in the early 1990s and coincide with the standardization of ISDN protocols for customer premises equipment (CPE). A further discussion of the PBX/Centrex market is provided in chapter VI.

The value of the market for key and hybrid telephone systems in the United States decreased somewhat from slightly more than $1.0 billion in 1984 to slightly less than $1.0 billion in 1985 and remained stable through 1987. The traditional market for key and hybrid systems has become fairly saturated in recent years. In addition, competition amoung vendors has resulted in stable to declining prices. The market is expected to increase slowly through the rest of the decade to about $1.0 billion as more key systems are sold in conjunction with Centrex. A further discussion of the key systems market is provided in chapter VI.

U..S. sales of all types of telephone sets jumped from $1.2 billion in 1984 to $1.6 billion in 1985 before slowing somewhat thereafter. In 1988, total U.S. sales amounted to $1.8 billion and are expected to increase to $1.9 billion by 1990. Much of the growth in this product area has come from sales of residential, consumer phones. As the market became saturated for cheap, throwaway phones in 1986, the market slowed. Growth since then has been predominently in higher end products. A more complete analysis of the consumer telecommunications equipment market follows in chapter VI.

One of the fastest growing segments of the U.S. telecommunications equipment market has been facsimiles. After a brief stall in 1985, U.S. sales of facsimile terminals increased rapidly from $164 million in 1984 to $539 in 1987, and is expected to experience explosive growth in the next couple of years and amount to $1.6 billion by 1990. Facsimile terminals have become extremely cost effective alternatives for rapid text communication. A detailed discussion of the U.S. facsimile market is presented in chapter VI.

The U.S. market for modems has increased steadily from $1.1 billion in 1984 to $1.6 billion in 1987 and is expected to continue to increase to almost $2.0 billion by 1990. The demand for modems has continued to increase as distributed data processing, local area networks, and information services has required more and more data communications over the telephone network. A more thorough discussion of the U.S. data communications equipment market is presented in chapter VI.

Sales of multiplexors in the United States has grown from $550 million in 1984 to $840 million in 1987, and will likely increase to $1.8 billion in 1990. The market for multiplexors is driven by the need to increase the capacity of telecommunications transmission media. Much of the increase has been accounted for by T1 multiplexors. T1 is a high-capacity digital transmission link that can be used to transmit voice or data through the use of a multiplexor. Further discus-

sion of multiplexors is included in the section on data communications equipment.

The market for local area networks (LAN), another rapidly growing data communications market, increased from $300 million in 1984 to $800 million in 1987 and is anticipated to grow to about $1.0 billion by 1990. LANS have developed due to the growth of the personal computer (PC) market in the United States. While PCs are great for independent data processing needs, more and more users need to communicate between PCs and with a host mainframe. Several computer vendors have developed unique LANS to support their own PCs and system architecture.

One of the major developments in telecommunications in the past several years has been the rapid deployment of fiber optics as a transmission medium. Sales of fiber optic systems and equipment increased from $410 million in 1984 to $1.0 billion in 1987. The market is expected to slow somewhat over the next couple of years due to the fiber optic saturation of the long distance networks, up to now the principal use of fiber optics. Once ISDN is implemented fiber optics will likely be required to carry the service to the residential customer. ISDN to the home is not likely to occur until the end of the century or even later.

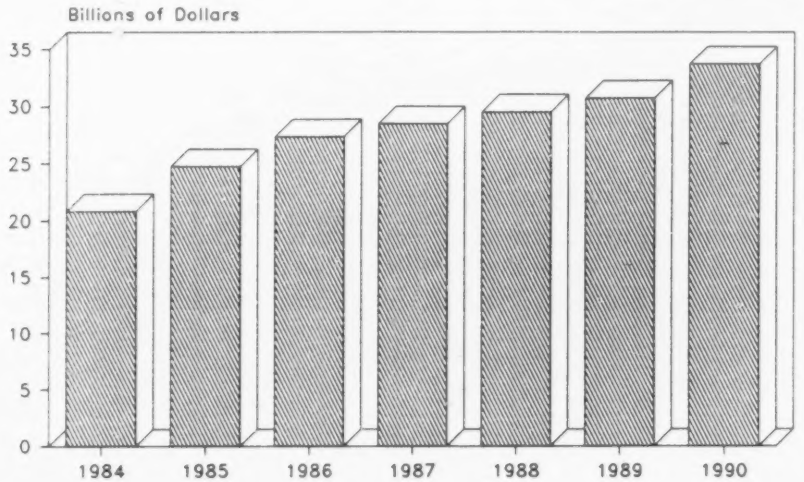
The market for radio communications equipment (excluding broadcast equipment) has increased over the last several years from $3.5 billion in 1984 to $4.2 billion in 1987. The three main segments of this sector are microwave communications links, satellite communications equipment (excluding the satellites themselves) and cellular telecommunications equipment.

The market for microwave and satellite communications equipment has been rather stagnant in recent years due to the deployment of fiber optics for long distance telecommunications. Cellular telecommunications however, has experienced significant growth since its inception in the early 1980s. A more detailed analysis of the cellular industry is presented in chapter VI.

Two other product categories which are growing in significance are call/voice handling equipment and pay telephones. Call/voice handling equipment, principally voice messaging systems and automatic call distributors, are becoming increasing important product offerings of interconnect vendors and are the chief method of distribution for these products. The total market for all call/voice handling equipment surged from $163 million in 1984 to $850 million in 1987, and is expected to almost $2.0 billion by 1990. The products and markets are discussed further in chapter VI.

Pay telephones are also becoming increasingly highlighted in the industry. Before 1984, pay telephones could only be installed and owned by the telephone company. Since June 1984, privately-owned payphones have been allowed. The total market for all pay telephones increased from $40 million in 1986 to $60 million in 1987. As pay telephones become to be used as remote information processing center, with more and more features, the market is likely to accelerate and amount to $185 million by 1990. The market for pay telephones is explored further in chapter VI.

Figure 1.--Value of the U.S. Telecommunications Equipment Market, 1984-90



Source: NATA Market Research Department

Table 1
Value of Selected U.S. Telecommunications
Equipment Markets, 1984-90

Equipment	1984	1985	1986	1987	1988(e)	1989(e)	1990(e)	*CAGR 1984-87	*CAGR 1988-90
	Millions of Dollars								
Private Branch Exchanges	2,843	3,086	3,105	3,050	3,000	3,100	3,150	2.37%	2.47%
Central Office Switches	2,900	4,750	5,500	5,100	5,050	4,975	5,025	20.68%	-0.25%
Key/Hybrid Telephone Systems	1,039	955	957	960	965	980	1,000	-2.60%	1.80%
Telephone Sets (all types)	1,200	1,585	1,685	1,750	1,825	1,875	1,890	13.39%	1.77%
Facsimile Equipment	175	164	260	539	1,100	1,475	1,650	45.44%	22.47%
Modems	1,100	1,266	1,500	1,650	1,848	1,910	1,950	14.46%	2.72%
Multiplexors (including T1)	550	613	700	840	1,050	1,400	1,800	15.14%	30.93%
Local Area Network Equipment	300	450	700	800	900	980	1,010	38.63%	5.93%
Fiber Optic Equipment	410	500	883	1,011	1,104	1,175	1,250	35.06%	6.41%
Radio Communications Equipment (mobile radio systems and radio communications links)	3,500	3,750	3,970	4,250	5,000	5,110	5,450	6.68%	4.40%
Other Telecommunications Equipment	6,835	7,665	8,102	8,568	7,697	7,740	9,617	7.82%	11.78%
Total Telecommunications Equipment	20,852	24,784	27,362	28,518	29,539	30,720	33,792	10.99%	6.96%

(e) Estimated
* Compound Annual Growth Rate

Source: NATA Market Research Department

CHAPTER III

U.S. TELECOMMUNICATIONS EQUIPMENT MANUFACTURING INDUSTRY

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U.S. TELECOMMUNICATIONS EQUIPMENT MANUFACTURING INDUSTRY

The U.S. telecommunications equipment manufacturing industry is one that typically specializes in high-end, high-technology products. Much of the manufacturing of consumer-oriented, relatively low-end products is conducted abroad and imported. As shown in Table 2, U.S. producers factory shipments of all types of telecommunications equipment increased from $19.7 billion in 1984 to almost $26.0 billion in 1987 and is expected to increase to 27.7 billion this year. Figure 2 shows growth rates of U.S. manufacturers' factory shipments during 1984-88. Most of the segments show some positive growth with the very notable exception of facsimile terminals. Despite an exploding market, U.S. manufacturers have virtually stopped fax production. Virtually all fax terminals are now manufacturered abroad and imported.

CO switches represented the most significant product area for U.S. producers accounting for an estimated 18 percent of the total value in 1988, up slightly from 17 percent in 1984 (see Fig. 2). Other significant product areas in 1988 included data communications equipment (18 percent), mobile radio communications systems (10 percent), common carrier line equipment (10 percent), miscellaneous switching apparatus (8 percent), PBXs (7 percent), and radio communications links (6 percent).

The relative health of the industry can be analyzed by reviewing such information as inventories, capital expenditures, etc. (see Table 3 and Fig. 3). Some of the indicators point to a rather healthy industry. Year-end inventories have followed a gradually increasing trend from $5.9 billion in 1984 to $6.4 billion in 1988. As a percent of total factory shipments, however, inventories have decreased from 26 percent in 1984 to 19 percent in 1988. Other positive factors include the decreasing cost of materials. As a percent of shipments, the cost of materials have decreased from 56 percent in 1984 to an estimated 31 percent in 1988. As a share of output, total wages are down due to stable to decreasing employment figures coupled with a rather stable wage rate. These indicators seem to point to an industry that is becoming more efficient in its production. Shipments are increasing more rapidly than costs and inventories. This would tend to indicate increased profitibility.

Other operating and financial ratios, however, present mixed results. Capacity utilization in 1986 was 84 percent (see table 4), higher than the average of 67 percent registered for all manufacturing industries and higher than 74 percent registered for computers and other office equipment. Research-and- development expenditures as a percent of net sales for communications equipment amounted to 5.7 percent compared to 11.8 percent for computers. The current and quick ratios for communications equipment were 1.7 and 0.8, respectively, compared to 1.6 and 1.0, respectively, for computers and other office equipment. Return on equity amounted to 7.6 percent for communications equipment and 14.0 percent for computers and other office equipment. Other ratios also show mixed results regarding the relative health of the communications equipment industry vis-a-vis the computer and other office equipment industry and vis-a-vis all manufacturing industries.

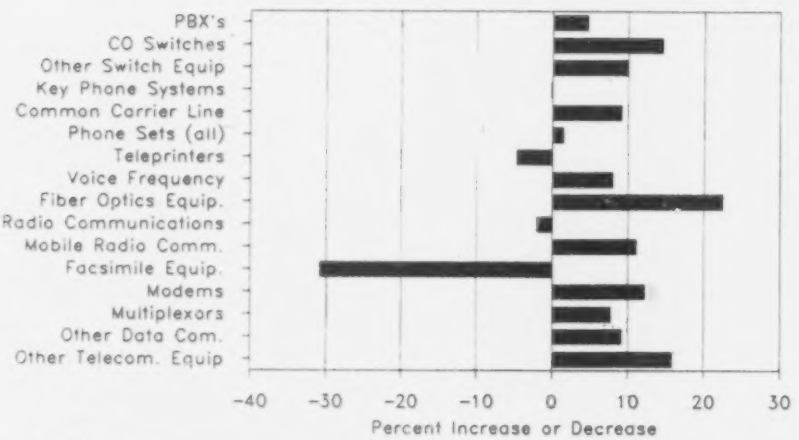
In general, the implications are that the communications equipment industry is getting increasingly more efficient and profitible, and, that at least by some measures, is healthier than the manufacturing sector as a whole; but that it is not as robust as certain other industries such as the computer/office equipment manufacturing industry. It is likely that the trend towards increasing efficiency will continue in the near future, and that capital expenditures will likely rise as the industry prepares for ISDN and the age of digital communications.

The prices that producers charge for their equipment for the first arm's length transaction has varied somewhat by product (see Table 5 and Fig. 4). Overall, for telephone and telegraph equipment (not including radio equipment or fiber optic systems), prices increased 8 percent from 1985 to 1987, but are expected to decrease somewhat in 1988. Prices of CO switches, being the least price sensitive of the different segments, increased almost 10 percent from 1985 to 1988. Prices of telephone sets, being the most price sensitive of the product segments decreased almost 10 percent between 1985 and 1987 before turning upwards slightly in 1988.

Prices for exports of U.S.-made telephone and

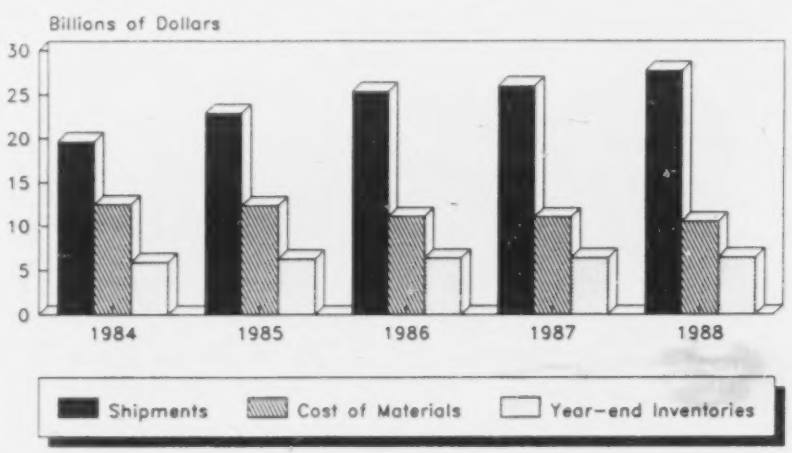
telegraph products increased almost 7 percent between 1985 and 1988, while imported prices for the same products increased almost 10 percent during the same time period. For radio and television communications equipment (includes mobile communications systems, radio communications links, fiber optics systems, and radio and television broadcast equipment) the comparisons are even more dramatic. Export prices remained just about constant between 1985 and 1988, while import prices increased by more than 15 percent.

Figure 2.--Annual Growth Rates of U.S. Manufacturers' Shipments of Selected Telecommunications Equipment, 1984-88



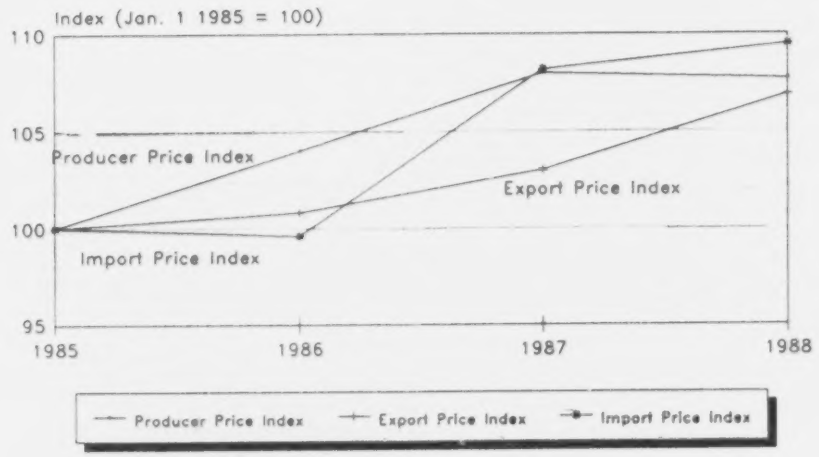
Source: U.S. Department of Commerce

Figure 3.-- Manufacturers' Shipments, Material Costs, and Year-end Inventories of Telecommunications Equipment



Source: U.S. Department of Commerce

Figure 4.--Comparison of Domestic, Import, & Export Prices for Telephone & Telegraph Equipment, 1985-88



Source: Bureau of Labor Statistics

Table 2
Value of U.S. Manufacturers' Factory Shipments of Selected
Telecommunications Equipment, 1984-88

Equipment	1984	1985	1986	1987	1988(e)	*CAGR
	- - - - - - Millions of Dollars - - - - - -					
Private Branch Exchanges	1,604	1,721	1,850	1,925	1,930	4.73%
Central Office Switches	2,857	4,333	5,330	5,125	4,920	14.55%
Other Switching Equipment	1,410	1,661	1,829	1,922	2,056	9.89%
Key Telephone Systems	895	880	876	886	878	-0.48%
Common Carrier Line Equipment	1,917	2,329	2,537	2,628	2,728	9.22%
Telephone sets (all types)	847	1,219	1,415	1,050	900	1.53%
Teleprinters	663	474	501	512	548	-4.65%
Voice Frequency Equipment	302	328	354	384	411	8.01%
Fiber Optics Equipment	254	529	568	570	572	22.50%
Radio Communications Links	1,678	1,953	1,887	1,765	1,543	-2.08%
Mobile Radio Communications Systems (including cellular radio systems)	1,818	1,782	2,139	2,567	2,772	11.12%
Facsimile Equipment	100	64	49	38	23	-30.75%
Data Communications Equipment:						
Modems	1,117	1,047	1,205	1,350	1,770	12.20%
Multiplexors	1,407	1,644	1,750	1,801	1,892	7.69%
Other Data Communications Equipment	830	648	765	972	1,180	9.19%
Other Telecommunications Equipment	2,001	2,305	2,276	2,455	3,598	15.80%
Total Telecommunications Equipment	19,700	22,917	25,331	25,950	27,721	8.91%

(e) Estimated by NATA Market Research Department
* Compound Annual Growth Rate

Source: Based on Data of the U.S. Department of Commerce

Table 3
Miscellaneous Industry Information
Related to the Production
of Telecommunications Equipment

Item	1984	1985	1986	1987	1988(e)	*CAGR
Shipments: $ millions	$19,700	$22,917	$25,331	$25,950	$27,721	8.91%
Year-end Inventories: $ millions	5,876	6,250	6,336	6,375	6,410	2.20%
New Capital Expenditurers: $ millions	1,350	1,246	1,123	1,175	1,238	-2.14%
Cost of Materials: $ millions	12,500	12,301	11,081	11,000	10,500	-4.27%
Value Added by Manufacture: $ millions	9,999	14,469	18,396	21,040	23,760	24.16%
Total Employment: 1,000s	234	239	223	213	212	-2.44%
Production Workers: 1,000s	131	128	110	106	106	-5.16%
Average hourly Wage: $	12.09	12.08	11.94	12.19	12.25	0.33%
Value Added per Employee: $ thousands	64	62	66	68	66	0.77%

(e) Estimated by NATA Market Research Department
* Compound Annual Growth Rate

Source: Based on Data of the U.S. Department of Commerce

Table 4
Selected Operating and Financial Ratios
for the Communications Equipment
Producing Industry; Computer and Other Office;
and All Manufacturing for 1986

Item	Communications Equipment	Computers et al.	All Manufacturing
Capacity Utilization (percent of total capacity)	84.0	74.0	67.0
R & D as a percent of Net Sales	5.7	11.8	N/A
Advertising as a percent of Net Sales	1.9	1.2	1.5
Current Ratio (Current Assets to Current Liabilities)	1.7	1.6	1.5
Quick Ratio (Liquid Assets to Current Liabilities)	0.8	1.0	0.9
Net Assets to Working Capital	3.7	2.7	N/A
Asset Turnover	0.9	0.6	1.1
Liabilities to Net Worth	2.4	1.4	1.4
Debt Ratio (Total Debt to Total Assets)	70.2	58.5	58.0
Return on Assets	3.5	10.6	4.4
Return on Equity	7.6	14.0	6.5
Retained Earnings to Net Income	45.3	36.2	25.0

Source: Almanac of Business and Industrial Financial Ratios:
1988 edition; Prentice Hall.

Table 5
Various Price Indices for Certain
Telecommunications Equipment, 1985-1988

Index	1985	1986	1987	1988*
	- - - - - - - Percent - - - - - - -			
Producer Price Index:				
Telephone and Telegraph Apparatus	100.0	104.0	108.0	107.7
Central Office Switches	100.0	101.6	108.3	109.9
Private Branch Exchanges (PBX)	100.0	99.7	96.7	96.9
Less than 400 Line PBX's	100.0	99.2	93.7	94.4
400 Lines and over PBX's	100.0	100.0	99.5	99.5
Data Communications Equipment	100.0	99.0	98.5	102.3
Telephone Sets	100.0	93.2	90.5	92.3
Export Price Index for Telephone and Telegraph Equipment	100.0	100.8	103.0	106.9
Export Price Index for Radio and Television Communications Equipment	100.0	99.1	99.4	100.8
Import Price Index for Telephone and Telegraph Equipment	100.0	99.6	108.2	109.5
Import Price Index for Radio and Television Communications Equipment	100.0	110.1	113.1	115.2

* As of July 1988

Source: Bureau of Labor Statisics

CHAPTER IV

FOREIGN TRADE

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FOREIGN TRADE

The U.S. trade balance in telecommunications equipment was negative throughout 1984-87, worsening from minus $1.2 billion to minus $2.5 billion during the period (see Fig. 5). The deficit is expected to grow more slowly in 1988 and amount to about minus $2.6 billion, and begin to decrease thereafter, as U.S. exports are stimulated. Isolated bright spots in the trade picture are 1) an increasing surplus with the EC and 2) a decreasing deficit with Canada.

International trade in telecommunications equipment is dependent on a variety of factors. Exchange rates, customs duties, historical trading relationships, and general economic conditions are all significant determinants of international trade. Changes in the exchange rate, for instance, has tended to have a stimulating effect on U.S. exports. The U.S. dollar has decreased almost 40 percent in value against a composit, trade-weighted, average of the currencies of our major trading partners since 1984. This has allowed U.S. products to be cheaper abroad, for the same price in dollar terms.

The most important factor influencing trade, however, is government intervention. Most countries around the world, have government-owned telecommunications authorities that provide telecommunications services to the public. These companies, frequently called PTTs (Post, Telephone, & Telegraph), are the largest, and sometimes, the only major purchaser of telecommunications equipment. PTTs usually favor domestic suppliers and international competition is foreclosed. Other nontariff barriers erected by the government, such as stringent certification procedures, import licenses, subsidies, etc. limit the amount of foreign participation in the local telecom market. This situation is beginning to change as PTTs are starting to liberalize their purchasing decisions.

Since the AT&T divestiture in 1984, the U.S. market has become the freest market in the world, with minimal tariff and nontariff barriers to trade. Other countries, especially the telecommunications users in those countries , have witnessed the benefits of the open market in the United States and are pressing for change.

Another factor keeping U.S. exports in check has been the imposition of export controls on high technology products, expecially to communist countries, which are potentially huge markets. In 1988, the international committee regulating such exports (COCOM) relaxed some of the restrictions. This development will likely stimulate U.S. exports.

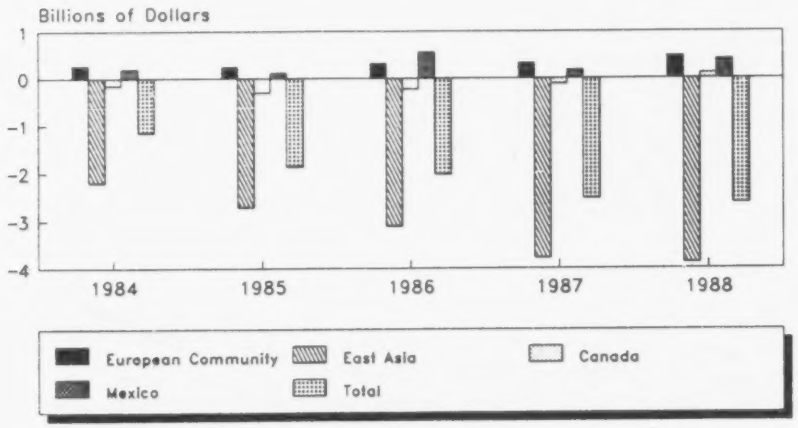
U.S. imports of telecommunications equipment increased from $3.5 billion in 1984 to $5.6 billion in 1987 and is expected to increase to $6.5 billion in 1988 (see Table 6). The largest source of imports throughout the period was Japan. Such imports increased from $1.6 billion in 1984 to $2.4 billion in 1987 and are expected to increase only slightly in 1988. The next largest source in 1987 was Taiwan with $721 million, followed by Canada with $453 million. Imports from the European Community fluctuated but generally increased from $145 million in 1984 to $243 million in 1987, and are expected to increase to $290 million in 1988.

The single largest identifiable product area in 1987 was telephone instruments accounting for 17 percent of the total. Such imports increased from $507 million in 1985 to $981 million in 1987 and expected to exceed $1.0 billion this year (see Table 7). Other large product categories in 1987 included facsimile equipment at $501 million, projected to increase to over $900 million in 1988 (Table 8); cordless telephones at $359 million in 1987 (Table 9); switching equipment at $346 million (Table 10); telephone answering equipment at $284 million (Table 11); and cellular telephones at $219 million (Table 12).

U.S. exports of telecommunications equipment increased from $2.3 billion in 1984 to $3.0 billion in 1987 and expected to increase to $3.8 billion in 1988 (see Table 15). The largest market for U.S.-made telecommunications equipment throughout the period was the European Community. Such exports increased steadily from $418 million in 1984 to $569 million in 1987 and is expected to jump to $775 million in 1988. Other important markets were Mexico $415 million in 1987 and Canada $332 million.

The largest category of U.S. exports in 1987, accounting for 13 percent, was telephone switching equipment. Such exports fluctuated but generally increased from $399 million in 1984 to $412 million in 1987 and are expected to increase substantially in 1988 to $542 million (Table 16). Tables 17 through 20

Figure 5.--Trade Balance with Selected Trading Partners and Total, for Telecommunications Equipment, 1984-88



Source: U.S. Department of Commerce

Table 6
U.S. Imports of Telecommunications Equipment, 1984-1988

Country	1984	1985	1986	1987	1988(e)
	Thousands of Dollars				
European Community:					
Belgium and Luxembourg	3,694	553	753	691	550
Denmark	5,923	4,234	3,262	2,309	2,250
France	48,502	94,490	41,181	73,549	82,150
Germany, West	34,352	49,772	44,891	49,761	53,175
Greece	1,225	792	1,741	1,178	1,200
Ireland	2,253	4,702	7,922	7,786	7,550
Italy	6,054	21,641	17,572	42,938	48,775
Netherlands	6,178	18,362	14,137	6,793	21,850
Portugal	3	25	20	189	250
Spain	3,987	14,516	14,367	2,417	175
United Kingdom	33,425	46,641	64,774	55,050	72,110
Total EC	145,596	255,728	210,617	242,662	290,035
East Asia					
Hong Kong	266,990	197,651	307,026	342,966	361,000
Japan	1,625,421	2,008,603	2,051,689	2,388,546	2,392,150
Korea, South	162,284	233,553	337,032	512,019	551,225
Singapore	142,121	207,579	260,861	355,364	410,200
Taiwan	373,442	458,127	586,783	721,127	785,300
Total East Asia	2,570,258	3,105,512	3,543,393	4,320,022	4,499,875
Canada	412,420	549,711	483,193	453,317	460,350
Mexico	108,758	196,634	209,484	238,884	210,000
Sweden	93,796	66,958	82,482	74,630	86,310
All Other	141,191	183,004	209,751	284,873	909,975
World	3,472,019	4,357,547	4,738,921	5,614,387	6,456,545

(e) Estimated by the NATA Market Research Department

Source: Compiled from official statistics of the U.S. Department of Commerce.

Note: Columns may not add due to rounding.

Table 7
Telephone Sets, All Types Except
Cordless and Cellular, 1984-88

Country	1984	1985	1986	1987	1988(e)
	- - - - - - - Thousands of Dollars - - - - - - -				
European Community:					
Belgium and Luxembourg	6	7	6	21	21
Denmark	1,420	273	204	43	45
France	656	6,879	1,171	901	910
German, West	651	4,835	6,565	5,905	5,700
Ireland	0	8	80	537	620
Italy	169	96	133	363	375
Netherlands	0	241	16	32	50
Spain	3,291	13,414	13,895	711	5,200
United Kingdom	640	1,117	5,341	5,961	6,100
Total EC	6,833	26,868	27,411	14,474	19,021
East Asia					
Hong Kong	97,770	60,423	107,884	111,123	115,500
Japan	190,172	176,422	370,953	340,460	320,000
Korea, South	43,453	71,999	99,333	141,262	162,300
Singapore	10,031	18,985	60,616	98,455	105,000
Taiwan	137,372	117,283	247,279	215,070	207,000
Total East Asia	478,798	445,111	886,065	906,370	909,800
Canada	10,447	24,538	25,076	27,275	31,225
Mexico	9,160	3,026	2,517	1,809	2,125
Sweden	319	418	5,145	1,424	1,200
All Other	1,971	671	16,385	35,861	47,329
World	507,526	500,632	962,599	987,213	1,010,700

(e) Estimated by the NATA Market Research Department

Source: Compiled from official statistics of the U.S. Department of Commerce.

Note: Columns may not add due to rounding.

Table 8
U.S. Imports of Facsimile Equipment, 1984-88

Country	*1984	*1985	1986	1987	1988(e)
	- - - - - - Thousands of Dollars - - - - - -				
European Community:					
Belgium and Luxembourg			18	0	0
Denmark			5	0	0
France			2	145	210
Germany, West			384	12	15
Italy			0	35	40
Netherlands			2	2	0
Spain			3	0	0
United Kingdom			549	543	540
Total EC			963	737	805
East Asia:					
Hong Kong			31	16	50
Japan			210,141	496,123	905,500
Korea, South			1	425	700
Singapore			0	111	325
Taiwan			24	974	5,250
Total East Asia			210,197	497,649	911,825
Canada			156	390	310
Mexico			7	188	275
Sweden			123	2,298	4,350
All Other			59	34	350
World			211,505	501,296	917,915

* Not Available
(e) Estimated by the NATA Market Research Department

Source: Compiled from official statistics of the U.S. Department of Commerce

Note: Columns may not add due to rounding.

Table 9
U.S. Imports of Cordless Telephones, 1984-88

Country	1984	1985	1986	1987	1988(e)
	- - - - - - Thousands of Dollars - - - - - -				
European Community:					
Denmark	0	1	0	0	0
France	1	16	4	2	2
Germany, West	68	21	0	79	80
Italy	271	0	0	0	0
Netherlands	1	0	2	0	0
Spain	329	0	0	6	5
United Kingdom	9	47	14	1,001	770
Total EC	678	86	19	1,087	857
East Asia					
Hong Kong	76,220	41,533	55,993	72,536	93,777
Japan	62,420	37,759	40,782	63,332	62,310
Korea, South	50,974	16,339	40,474	92,274	90,766
Singapore	13	212	3,553	40,811	57,375
Taiwan	80,757	73,309	85,400	86,804	80,664
Total East Asia	270,385	169,152	226,202	355,756	384,892
Canada	32	416	8	4	40
Mexico	0	0	0	0	390
Sweden	6	15	0	7	0
All Other	19	93	2,632	2,084	3,152
World	271,120	169,763	228,861	358,938	389,331

(e) Estimated by the NATA Market Research Department

Source: Compiled from official statistics of the U.S. Department of Commerce.

Note: Columns may not add due to rounding.

Table 10
U.S. Imports of Telecommunications
Switching Equipment, 1984-88

Country	*1984	*1985	1986	1987	1988(e)
	- - - - - - Thousands of Dollars - - - - - -				
European Community:					
Belgium and Luxembourg	707	0	0	0	0
Denmark	125	205	58	27	27
France	6,192	27	3	0	0
Germany, West	353	15,175	4,519	2,034	2,100
Ireland	330	1,954	531	10,641	10,960
Italy	160	30	79	2,135	2,200
Netherlands	40	6	277	56	58
Portugal	1	610	37	349	360
Spain	6	87	7	0	0
United Kingdom	4,182	2,379	1,941	590	620
Total EC	12,095	20,473	7,451	15,832	16,325
East Asia					
Hong Kong	1,953	904	911	1,567	1,620
Japan	328,660	206,111	127,556	103,068	101,000
Korea, South	10,055	21,419	5,152	12,578	13,700
Singapore	666	10	66	30	20
Taiwan	14,404	12,351	6,451	4,814	5,200
Total East Asia	355,738	240,795	140,136	122,057	121,540
Canada	166,058	215,577	148,796	160,794	175,000
Mexico	6,648	9,130	7,832	7,395	7,500
Sweden	13,613	18,526	3,525	29,690	37,000
All Other	13,623	21,030	19,276	9,985	935
World	567,775	525,531	327,016	345,754	358,300

* Includes imports of Key telephone systems.
(e) Estimated by the NATA Market Research Department

Source: Compiled from official statistics of the U.S. Department of Commerce

Note: Columns may not add due to rounding.

Table 11
U.S. Imports of Telephone
Answering Machines, 1984-88

Country	1984	1985	1986	1987	1988(e)
	- - - - - - Thousands of Dollars - - - - - -				
European Community:					
Belgium and Luxembourg	0	0	0	10	13
Denmark	0	0	0	0	0
Germany, West	1	0	75	194	85
Spain	117	4	5	0	0
United Kingdom	4	6	53	11	35
Total EC	122	10	133	215	133
East Asia:					
Hong Kong	34,126	37,283	64,092	58,785	55,275
Japan	119,298	97,444	120,042	82,101	75,350
Korea, South	18,484	43,848	66,428	82,992	93,150
Singapore	10,697	20,179	23,159	43,412	51,125
Taiwan	2,432	967	2,872	14,025	16,320
Total East Asia	185,037	199,721	276,593	281,315	291,220
Canada	69	80	114	212	215
Sweden	9	2	0	0	0
All Other	17	142	1,311	2,137	48,872
World	185,254	199,955	278,151	283,879	340,440

(e) Estimated by the NATA Market Research Department

Source: Compiled from official statistics of the U.S. Department of Commerce.

Note: Columns may not add due to rounding.

Table 12
U.S. Imports of Cellular Telephones, 1984-88

Country	*1984	*1985	1986	1987	1988(e)
	- - - - - - Thousands of Dollars - - - - - -				
European Community:					
Denmark			4	4	0
France			0	88	0
Germany, West			1	2	10
Netherlands			0	0	1
United Kingdom			2,771	3,961	5,375
Total EC			2,776	4,055	5,386
East Asia:					
Hong Kong			15,290	18,761	26,210
Japan			53,899	120,987	122,350
Korea, South			22,583	45,043	73,750
Singapore			6	4,657	75,125
Taiwan			386	11,824	53,250
Total East Asia			92,165	201,273	350,685
Canada			1,001	6,423	7,750
Mexico			393	1,104	550
Sweden			8	31	375
All Other			7,810	6,530	5,370
World			104,153	219,416	370,116

* Not Available
(e) Estimated by the NATA Market Research Department

Source: Compiled from official statistics of the U.S. Departement of Commerce.

Note: Columns may not add due to rounding.

Table 13
U.S. Imports of Key Telephone Systems, 1984-88

Country	*1984	*1985	1986	1987	1988(e)
			Thousands of Dollars		
European Community:					
Belgium and Luxembourg			0	4	4
France			30	0	33
Germany, West			3,222	7,070	7,918
Italy			0	16	18
Netherlands			5	0	0
United Kingdom			80	1,422	1,593
Total EC			3,338	8,512	9,566
East Asia					
Hong Kong			257	50	56
Japan			37,432	22,397	25,085
Korea, South			22,636	31,755	35,566
Singapore			0	2	0
Taiwan			6,494	10,969	12,285
Total East Asia			66,820	65,173	72,993
Canada			8,969	4,916	5,506
Mexico			1,635	90	100
Sweden			406	0	250
All Other			18	180	30
World			81,185	78,871	88,445

* Not Available
(e) Estimated by the NATA Market Research Department

Source: Compiled from official statistics of the U.S. Department of Commerce

Note: Columns may not add due to rounding.

Table 14
U.S. Imports of Communications
Satellite Equipment, 1984-88

Country	*1984	1985	1986	1987	1988(e)
	- - - - - - Thousands of Dollars - - - - - -				
European Community:					
Belgium and Luxembourg		0	73	3	4
Denmark		0	0	1	0
France		44,044	0	27	50
Germany, West		4,180	11,018	4,600	0
Italy		0	373	500	250
Netherlands		0	50	0	0
United Kingdom		1,374	1,602	208	500
Total EC		49,598	13,117	5,341	804
East Asia:					
Hong Kong		0	49	67	70
Japan		109	544	3,139	5,250
Korea, South		0	7	251	310
Singapore		0	2	0	0
Taiwan		149	183	345	520
Total East Asia		259	786	3,802	6,150
Canada		682	1,719	3,059	3,210
Mexico		0	2	10	0
Sweden		0	1	0	0
All Other		4	300	81	210
World		50,543	15,924	12,292	10,374

* Not Available
(e) Estimated by the NATA Market Research Department

Source: Compiled from official statistics of the U.S. Department of Commerce.

Note: Columns may not add due to rounding.

Table 15
U.S. Exports of Telecommunications Equipment

Country	1984	1985	1986	1987	1988(e)
	Thousands of Dollars				
European Community:					
Belgium and Luxembourg	13,423	20,020	27,670	20,699	31,961
Denmark	8,273	11,778	4,989	7,243	8,450
France	41,750	44,075	38,472	42,678	50,175
Germany, West	94,224	102,228	108,821	103,587	157,370
Greece	3,893	3,745	4,284	9,125	14,495
Ireland	18,479	8,181	8,797	8,315	9,250
Italy	34,090	36,120	35,976	44,850	45,750
Netherlands	30,038	71,267	83,626	79,051	67,513
Portugal	2,589	1,899	5,248	6,394	8,475
Spain	19,890	30,778	21,286	21,841	25,674
United Kingdom	150,914	179,347	191,245	225,381	355,700
Total EC	417,564	509,438	530,413	569,166	774,813
East Asia					
Hong Kong	44,478	39,560	49,291	58,761	72,212
Japan	74,283	106,185	138,655	175,485	182,505
Korea, South	141,318	132,989	103,707	68,321	101,372
Singapore	38,062	32,573	36,127	65,335	72,111
Taiwan	70,831	84,926	101,191	173,754	195,306
Total East Asia	368,973	396,233	428,972	541,656	623,506
Canada	256,858	246,547	250,790	331,740	575,552
Mexico	310,558	313,978	373,829	415,167	612,773
Brazil	85,380	109,769	211,853	286,420	410,875
All Other	881,507	915,281	912,493	920,452	833,231
World	2,320,839	2,491,245	2,708,351	3,064,600	3,830,750

(e) Estimated by the NATA Market Research Department

Source: Compiled from official statistics of the U.S. Department of Commerce

Note: Columns may not add due to rounding.

Table 16
U.S. Exports of Telephone Switching

Country	1984	1985	1986	1987	1988(e)
	- - - - - - Thousands of Dollars - - - - - -				
European Community:					
Belgium and Luxembourg	4,989	3,774	7,940	5,661	3,410
Denmark	56	73	366	444	310
France	1,102	827	973	2,133	1,150
Germany, West	2,376	5,917	2,869	6,914	6,820
Greece	266	73	422	358	875
Ireland	7,814	940	1,766	1,960	1,072
Italy	7,554	8,218	4,709	3,738	2,250
Netherlands	9,670	53,766	51,953	29,267	41,112
Portugal	0	0	0	505	335
Spain	111	1,035	466	1,912	2,021
United Kingdom	24,190	28,075	26,981	25,541	65,332
Total EC	58,130	102,697	98,446	78,432	124,687
East Asia:					
Hong Kong	7,012	10,226	11,980	10,011	19,375
Japan	7,764	15,132	45,433	35,178	48,222
Korea, South	85,860	53,494	29,800	19,648	25,350
Singapore	4,486	2,569	4,945	12,336	17,260
Taiwan	12,324	15,723	23,641	80,308	95,312
Total East Asia	117,445	97,144	115,799	157,480	205,519
Canada	52,028	49,721	46,129	57,979	72,380
Mexico	5,931	15,284	20,925	9,334	20,110
Brazil	762	1,642	1,905	4,006	4,110
All Other	164,936	96,185	111,138	104,445	115,335
World	399,234	362,673	394,342	411,677	542,141

(e) Estimated by the NATA Market Research Department

Source: Compiled from official statistics of the U.S. Department of Commerce.

Note: Columns may not add due to rounding.

Table 17
U.S. Exports of Fiber Optics Equipment

Country	1984	1985	1986	1987	1988(e)
	Thousands of Dollars				
European Community:					
Belgium and Luxembourg	657	1,092	795	456	500
Denmark	4	2	7	174	250
France	817	876	5,828	6,514	5,210
Germany, West	11,855	9,043	24,773	8,035	10,221
Greece	0	0	0	2	13
Ireland	0	0	0	0	25
Italy	1,821	1,767	1,329	1,245	1,565
Netherlands	54	164	3,791	3,953	565
Portugal	0	0	19	0	470
Spain	8	607	726	2,312	2,301
United Kingdom	5,501	4,544	4,016	4,561	2,200
Total EC	20,717	18,094	41,283	27,252	23,320
East Asia:					
Hong Kong	53	0	2	26	43
Japan	483	4,416	2,897	10,695	17,690
Korea, South	1,015	441	128	282	310
Singapore	10	11	11	84	115
Taiwan	11	70	154	2,946	13,022
Total East Asia	1,572	4,938	3,193	14,031	31,180
Canada	1,732	5,396	10,219	13,435	12,250
Mexico	0	390	310	615	975
Brazil	1	134	300	331	210
All Other	2,248	5,514	12,798	9,610	20,005
World	26,270	34,465	68,102	65,274	87,940

(e) Estimated by the NATA Market Research Department

Source: Compiled from official statistics of the U.S. Department of Commerce.

Note: Columns may not add due to rounding.

Table 18
U.S. Exports of Telephone Instruments

Country	1984	1985	1986	1987	1988(e)
	Thousands of Dollars				
European Community:					
Belgium and Luxembourg	91	151	148	260	365
Denmark	24	38	66	42	45
France	67	471	146	290	315
Germany, West	417	152	259	530	700
Greece	48	21	48	247	375
Ireland	52	52	8	394	510
Italy	272	467	1,063	2,229	3,300
Netherlands	153	39	109	632	770
Portugal	1	10	1	39	50
Spain	1,435	2,337	1,869	52	75
United Kingdom	1,944	661	2,372	7,505	9,755
Total EC	4,504	4,397	6,088	12,219	16,260
East Asia:					
Hong Kong	5,307	2,835	4,824	7,974	12,560
Japan	3,396	4,363	2,338	8,662	9,555
Korea, South	1,698	357	504	3,508	4,312
Singapore	567	288	395	1,334	3,755
Taiwan	1,251	2,831	3,815	3,530	5,612
Total East Asia	12,219	10,673	11,876	25,008	35,794
Canada	4,957	5,689	7,560	9,179	11,215
Mexico	1,045	1,107	2,152	1,281	1,854
Brazil	981	1,691	405	218	350
All Other	13,289	13,764	9,462	17,967	19,260
World	36,996	37,322	37,543	65,873	84,733

(e) Estimated by the NATA Market Research Department

Source: Compiled from official statistics of the U.S. Department of Commerce.

Note: Columns may not add due to rounding.

Table 19
U.S. Exports of Modems

Country	*1984	*1985	1986	1987	1988(e)
			Thousands of Dollars		
European Community:					
Belgium and Luxembourg			142	146	150
Denmark			56	11	15
France			1,182	1,456	3,500
Germany, West			808	389	425
Greece			81	14	15
Ireland			13	42	55
Italy			344	285	1,122
Netherlands			449	238	997
Portugal			19	28	33
Spain			26	2	10
United Kingdom			2,976	6,058	10,332
Total EC			6,096	8,667	16,654
East Asia					
Hong Kong			218	448	770
Japan			974	10,483	15,250
Korea, South			442	370	560
Singapore			179	403	550
Taiwan			118	405	775
Total East Asia			1,932	12,109	17,905
Canada			2,174	5,267	7,880
Mexico			1,064	1,918	2,022
Brazil			36	82	15
All Other			7,489	4,559	5,250
World			18,791	32,602	49,726

* Not Available
(e) Estimated by the NATA Market Research Department

Source: Compiled from official statistics of the U.S. Department of Commerce.

Note: Columns may not add due to rounding.

Table 20
U.S. Exports of Teleprinters

Country	1984	1985	1986	1987	1988(e)
	- - - - - - Thousands of Dollars - - - - - -				
European Community:					
Belgium and Luxembourg	230	203	28	52	1,100
Denmark	39	34	11	2	0
France	329	166	827	514	475
Germany, West	1,590	545	299	314	350
Greece	9	18	65	3	15
Ireland	17	44	10	64	400
Italy	1,233	530	60	180	202
Netherlands	1,093	977	173	26	57
Portugal	10	32	4	33	52
Spain	207	104	645	121	175
United Kingdom	1,492	2,050	1,294	580	610
Total EC	6,250	4,701	3,416	1,889	3,436
East Asia:					
Hong Kong	188	147	132	393	410
Japan	1,170	559	654	559	570
Korea, South	27	562	195	223	225
Singapore	199	46	77	129	136
Taiwan	172	1,028	778	127	182
Total East Asia	1,756	2,342	1,836	1,432	1,523
Canada	3,892	4,891	4,665	5,928	9,223
Mexico	2,300	221	1,126	2,021	3,665
Brazil	78	13	0	118	180
All Other	8,832	4,524	5,948	7,062	8,223
World	23,107	16,693	16,990	18,450	26,250

(e) Estimated by the NATA Market Research Department

Source: Compiled from official statistics of the U.S. Department of Commerce.

Note: Columns may not add due to rounding.

CHAPTER V

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TELECOMMUNICATIONS SERVICES

OVERVIEW

The market for telecommunications services encompasses a wide variety of services from simple "dial tone" to on-line data base access, packet switching, video conferencing, and private networks. The market can be divided into the services provided by fairly distinct and separate types of service providers--local exchange carriers, interexchange carriers, and specialized carriers such as information service providers.

The U.S. telecommunications network links telephonic and computer equipment for voice, text, data, and video transmission. About 85 percent of traffic on the public network is voice telephone communication, data traffic accounts for about 10 percent, and video and other specialized transmission accounts for the balance of domestic telecommunications. In 1987, over 400 billion telephone calls were placed over the public network, of which almost 90 percent were local. On average, each person makes about 2,000 calls a year, or almost 5.5 per day. Business accounts for about 20 percent of long-distance domestic telephone use, residential users account for 71 percent while government and specialized use make up the balance. More than 63 percent of all calls are made during regular business hours. Nearly 94 percent of all households in the United States have telephone service.

Telecommunications service infrastructure investments currently account for more than a tenth of gross fixed capital formation in the United States and Western Europe. According to a study conducted by "Telecommunications, Products, and Technology Magazine" which surveyed some 1,500 businesses with over 50 employees, the average telecommunications budget in 1988 is about $9 million or 1 percent of its operating budget. This is up from $8 million in 1987 and $7 million in 1986. The largest business telecommunications users will spend considerably more than the average. In 1988 banks and other financial institutions will spend $17 million, the Federal Government--$14 million, transportation carriers--$12 million, and manufacturers will spend $11 million.

Since much of the industry is regulated, it traditionally has been guaranteed a certain rate of return. Several indicia point to a relatively healthy industry. In 1986 the cost of operations amounted to 28.9 percent of net sales. Net profit amounted to almost 6 percent of net sales and return on equity was almost 5 percent (see Table 21).

Technological convergence has reduced the structural differences between the data processing and telecommunications industries, leading to overlapping markets and customers. The technical interaction of computing and telephony can be characterized by the functional allocation of processing "intelligence" within the telecommunications network. In the new generation of telephone technology, remotely distributed digital processors are programmed to function independently from central office switches without the centralized signaling instructions that have defined traditional network architecture. In addition, the network provides interconnection for CPE ranging from computer terminals with data processing capabilities to facsimile terminals, voice messaging systems, integrated voice-data work stations, and PBXs.

One of the key market developments in 1987 was the testing of technical standards for the Intergrated Services Digital Network (ISDN). In 1987 the ISDN was undergoing at least 23 tests. AT&T was involved with six such trials, Siemens with six, NEC with four, Northern Telecom with three, Ericsson with two, and GTE with two. While many of the network standards have been establised, the standards for terminal equipment have not. It is likely that ISDN will not become commercially viable for several more years. However, in the long run, most analysts believe that ISDN will be a major economic and technological force that will drive competition in the telecommunications industry.

Others, however, feel that the customer does not want or need anything more than "plain old telephone service" (POTS), but nonetheless, will be required to foot the bill for the development of ISDN, which will primarily benefit large business customers. Furthermore, critics argue that the full benefits of ISDN will not be realized until every potential household and business has subscribed, and that may never happen.

Table 21
Selected Operating and Financial Ratios for the
Communications Industry* for 1986

Item	Ratio
Cost of Operations as a Percent of Net Sales	28.9
Advertising as a Percent of Net Sales	0.7
Net Profit as a Percent of Net Sales	5.9
Current Ratio (Current Assets to Current Liabilities)	1.0
Quick Ratio (Liquid Assets to Current Liabilities)	0.8
Asset Turnover	0.4
Liabilitied to Net Worth	1.1
Debt Ratio (Total Debt to Total Assets)	52.2
Return on Assets	4.1
Return on Equity	4.7

* Includes all telecommunications service providers.

Source: Almanac of Business and Industrial Financial Ratios: 1988 Edition; Prentice Hall

LOCAL EXCHANGE MARKET

Local exchange telephone companies provide service only with designated areas, for companies which once comprised the Bell Telephone System these areas are called Local Access and Transport Areas (LATA). Within each serving area, a telephone company provides a myriad of services. These services can be divided into two basic categories--exchange service and exchange access. Exchange access services connect customers to long distance carriers, while exchange services are the telecommunications services provided within the serving area. The services themselves range from simple dial tone service to specialized customer services and system features such as hunt groups, call waiting, call forwarding, and Centrex services. Beginning this year, local telephone companies are being allowed to provide voice messaging services.

Based on information from the Federal Communications Commission, the prices of all goods and services increased by 9 percent between January 1985 and December 1987, while the average prices of all telephone services increased by 6 percent during the same period. Comparing the different services during the same time period, prices for local residential services increased 25 percent, local business services increased 6 percent, intrastate long distance decreased 5 percent, and interstate long distance decreased 24 percent.

There are currently hundreds of companies across the United States that offer local telephone service. In general they can be grouped into two categories--companies that were divested from AT&T in 1984, commonly called the Bell Operating Companies (BOC), and the independent telephone companies. There are 22 BOCs, that are grouped into seven Regional Holding Companies, commonly called RBOCs, and hundreds of independent telephone companies. The RBOCs have an estimated 75 to 80 percent of the local exchange business.

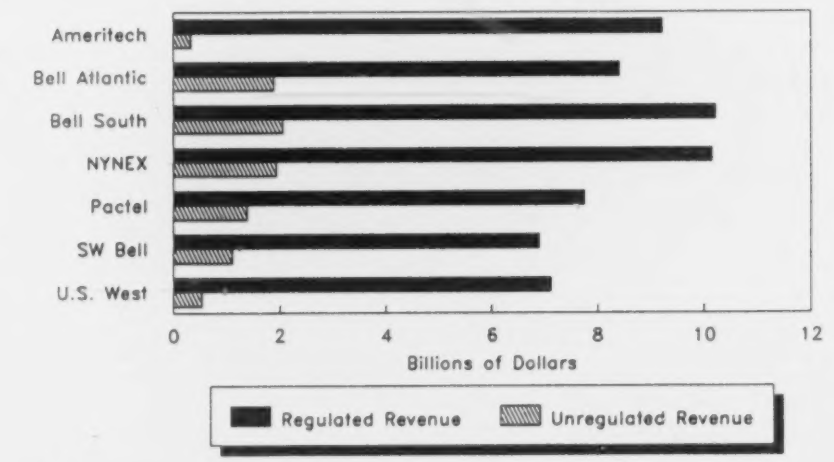
The seven RBOCs are Ameritech, Bell Atlantic, BellSouth, NYNEX, Pacific Telesis (commonly called PacTel), Southwestern Bell, and U S West. In 1987, total revenue of all RBOCs amounted to $69.0 billion, of which 87 percent was from regulated telephone service (see Table 22). BellSouth and NYNEX earned the most total revenue, each more than $12 billion (see Fig. 6). In terms of profitibility, each of the RBOCs had net income of 10 percent or more as a share of revenue. BellSouth was the highest with 14 percent and PacTel was the lowest with 10 percent (see Fig. 7). Total revenues and access lines of the individual BOCs are presented in Table 23. Figure 8 shows estimated CPE sales by RBOC for 1986 and 1988.

In terms of total revenue in 1987, the largest independent telephone companies were GTE ($15.4 billion), United Telecommunications ($3.0 billion), Contel ($2.9 billion), and Centel ($1.5 billion). Total estimated 1987 revenue of all independent telephone companies amounted to $32.5 billion (see Table 24 and Fig. 9). Of the top four, profitability varied greatly from a high of 11 percent of revenue for Centel to a low of minus 2 percent for United. Virtually all of the fluctuation in profitability is related to revenue and expenses from nonlocal exchange business. The top 25 independent telephone companies with their associated access lines and revenue are presented in Table 25.

For the major independents, the BOCs and AT&T, the allowed rate of return on regulated communication service in 1987 ranged from a low of 5.32 percent for Anchorage Telephone Utility to a high of 19.96 percent for GTE North, Inc. (see Table 26). The rate of return for local exchange companies are determined by each individual state public utilities commission. The Federal Communications Commission regulates interstate telecommunications.

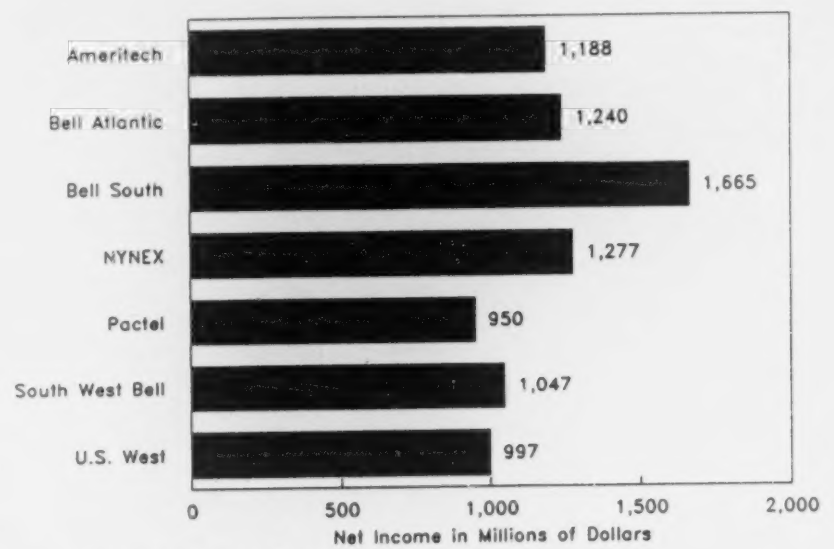
On average, for all local exchange carriers net operating income (after taxes) amounted to 18.12 percent of operating revenue (see Table 27). Total operating revenues per company access line amounted to $643 for 1987. Operating expenses per company access line amounted to $432. The ratio of operating expenses to total operating expenses amounted to 67.2 percent. In total, at the end of 1987, all local exchange carriers had $214 billion in communication plant and equipment (see Table 28). The largest segment was central office equipment, principally switches. This amounted to $76 billion at the end of 1987. The next largest category was cable. The value in place of all types of cable amounted to $67.1 billion. The value of buildings amounted to $16 billion, station connections amounted to $15 billion and underground conduit amounted to $11 billion.

Figure 6.--Revenue Breakdown By RBOC, 1987



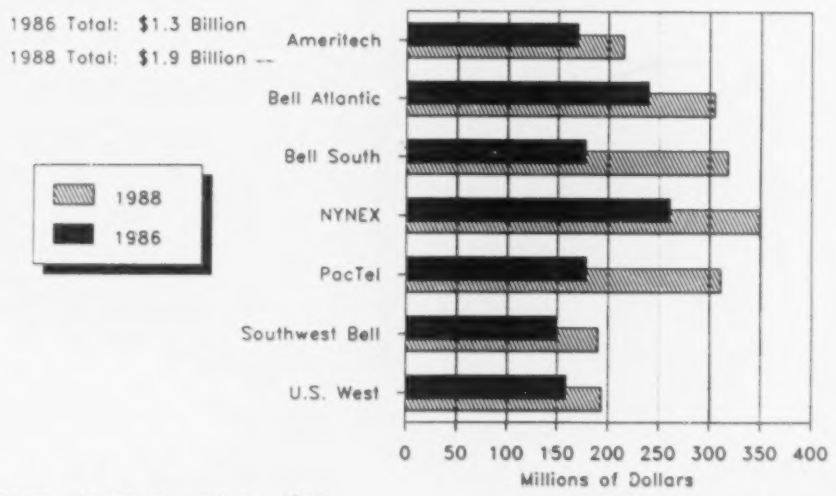
Source: Individual Annual and 10K Company Reports

Figure 7.--Net Income By RBOC, 1987



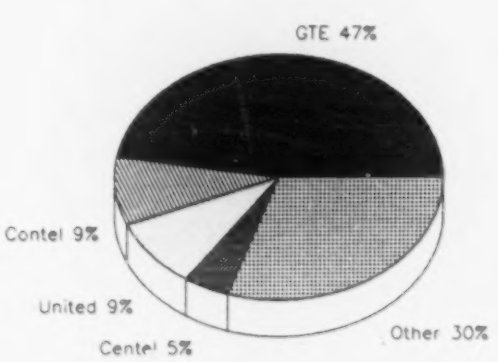
Source: Individual Company Reports

Figure 8.--RBOC Sales of CPE, 1986 and 1988



Source: Telephony, April 11, 1988

Figure 9.--Revenue of Independent Telephone Companies, 1987



Total--$32.5 Billion

Source: Individual Company Reports

Table 22
Selected Financial Information of the Regional Bell Operating Companies
As of December 31, 1987

	Ameritech	Bell Atlantic	Bell-South	NYNEX	PACTEL	SW Bell	US West	Total or Average
Revenue: $ millions	9,536	10,298	12,269	12,084	9,131	8,003	7,651	68,972
Regulated: $ millions	9,217	8,412	10,216	10,152	7,750	6,902	7,122	59,771
Unregulated: $ millions	319	1,886	2,053	1,932	1,381	1,101	529	9,201
Expenses and Income Tax: $ millions	8,348	9,058	10,604	10,807	8,181	6,956	6,654	60,608
Net Income: $ millions	1,188	1,240	1,665	1,277	950	1,047	997	8,364
Earnings per Share: $	8.47	6.24	3.46	6.26	2.21	3.48	5.31	5.06
Dividends per Share: $	5.10	3.84	2.20	3.80	1.64	2.32	3.28	3.16
Avg. Shares Outstanding: millions	140	199	481	204	431	301	190	278
Total Assets: $ millions	18,784	21,245	27,417	22,786	21,056	21,500	19,095	21,698
Long Term Debt: $ millions	4,389	5,199	6,320	6,076	5,321	5,649	4,949	5,415
Customer Access Lines: thousands	15.1	16.1	15.7	14.4	12.5	11.1	11.6	96.5
Number of Employees: thousands	78.5	81.0	98.7	95.3	71.9	67.1	68.5	561.0

Source: Individual Annual and 10K Company Reports.

Table 23
Local Bell Operating Companies:
Total Access lines and Operating Revenue
As of December 31, 1987

	Access Lines (thousands)	Operating Revenue ($ millions)
Bell Atlantic Corporation		
The Bell Telephone Co. of Pennsylvania	4,975.2	2,666.7
New Jersey Bell	4,657.0	2,654.1
C&P of Maryland	2,627.7	1,450.6
C&P of Virginia	2,420.8	1,459.4
C&P (Washington, D.C.)	872.6	474.4
C&P of West Virginia	666.0	483.9
Diamond State Telephone	388.7	205.5
Bell South Corporation		
Southern Bell Telephone & Telegraph Co.	8,976.4	6,426.6
South Central Bell Telephone Co.	6,763.1	4,677.7
Ameritech		
Illinois Bell	5,062.4	2,557.0
Michigan Bell	4,011.1	2,188.8
Ohio Bell	3,128.8	1,746.2
Wisconsin Bell	1,611.9	906.4
Indiana Bell	1,543.2	737.2
NYNEX		
New York Telephone Co.	9,429.9	7,343.3
New England Telephone and Telegraph Co.	5,245.3	3,407.4
Pacific Telesis		
Pacific Bell	12,596.3	7,647.8
Nevada Bell	199.4	3,407.4
U.S. West Inc.		
Mountain States Telephone and Telegraph Co.	5,507.7	3,646.7
North Western Bell Telephone Co.	3,511.5	2,186.5
Pacific Northwest Bell Telephone Co.	2,740.0	1,672.9
Southwestern Bell Corp.		
South Western Bell Telephone Co.	11,288.6	7,129.4

Source: Federal Communications Commission

Table 24
Selected Financial Information of the Top Four
Independant Telephone Companies
As of December 31, 1987

	GTE	United	Contel	Centel	*Other Independants	Total
Revenue: $ millions	15,421	2,982	2,905	1,476	9,764	32,548
Expenses and Income Taxes: $ millions	14,302	3,034	2,862	1,319	9,221	30,738
Net Income: $ millions	1,119	(52)	43	157	543	1,810
Earnings per Share: $	3.29	(0.55)	0.55	3.59	N/A	N/A
Dividends per Share: $	2.48	1.92	1.97	1.68	N/A	N/A
Average Shares Outsanding: millions	329	100	78	120	N/A	N/A
Total Assets: $ millions	28,745	6,558	5,513	3,014	N/A	N/A
Long Term Debt: $ millions	9,587	3,048	1,848	883	N/A	N/A
Customer Access Lines: thousands	13.6	3.5	2.4	1.4	9.0	29.9
Number of Employees: thousands	161.0	23.3	21.7	12.6	76.4	295.0

* Estimated by the NATA Market Research Department

Source: Individual Annual and 10K Company Reports

Table 25
Top 25 Independent Telephone Companies
by Access Lines

	Total* Access Lines	Total** Revenue
GTE Corp.; Stamford, CT	13.6	15.4
United Telecommunications; Overland Park, KS	3.5	3.0
Contel; Atlanta, GA	2.4	2.9
Centel; Chicago, IL	1.4	1.5
Southern New England Telephone Co.; New Haven, CT	1.8	1.4
ALLTEL; Hudson, OH	1.0	0.6
Cincinnati Bell; Cincinnati, OH	0.7	0.5
Puerto Rico Telephone Co.; San Juan, Puerto Rico	0.5	0.4
Rochester Telephone Co.; Rochester, NY	0.3	0.2
Century Telephone; Monroe, LA	0.3	0.2
Pacific Telecom; Vancouver, WA	0.3	0.2
Telephone and Data Systems; Madison, WI	0.3	0.2
Lincoln Telephone and Telegraph; Lincoln, NB	0.3	0.2
C-TEC Corporation; Wilkes Barre, PA	0.3	0.2
Anchorage Telephone; Anchorage, AK	0.2	0.2
Citizens Utilities Company; Stamford, CT	0.2	0.2
Puerto Rico Comms. Authority, Santurce, Puerto Rico	0.2	0.1
North State Telephone Co.; High Point, NC	0.2	0.1
Illinois Consolidated Telephone Co.; Matoon, IL	0.1	0.1
The Concord Telephone Co.; Concord, NC	0.1	0.1
CP National Corporation; Walnut Creek, CA	0.1	0.2
North West Telecommunications; Tomah, WI	0.1	0.1
Lufkin-Conroe Telephone Exchange; Lufkin, TX	0.1	0.1
Roseville Telephone Company; Roseville, CA	0.1	0.1
Universal Telephone Inc.; Milwaukee, WI	0.1	0.1

* Millions of access lines.
** Total revenue from all sources in billions of dollars.

Source: Various Company Annual Reports and Selected Industry Sources.

Table 26
Rate of Return on Utility Rate Base for Selected Telephone Carriers

Telephone Carriers	Rate of Return 1/	
	1987	1986
1. Alascom, Inc.	10.82%	10.38%
2. Anchorage Telephone Utiltiy	5.32%	9.89%
3. AT&T Communications, Inc.	10.80%	10.30%
4. Bell Telephone Company of Pennsylvania	10.22%	7.52%
5. Carolina Telephone & Telegraph Co	11.62%	11.15%
6. Central Telephone Co	11.13%	11.28%
7. Central Telephone Co. of Florida	9.20%	9.59%
8. Central Telephone Co. of Illinois	11.26%	12.01%
9. Central Telephone Co. of Virginia	11.60%	10.46%
10. Chesapeake & Potomac Telephone Co	8.27%	10.42%
11. Chesapeake & Potomac Telephone Co. of Maryland	8.69%	9.32%
12. Chesapeake & Potomac Telephone Co. Virgina	10.66%	10.46%
13. Chesapeake & Potomac Telephone Co. West Virginia	8.04%	9.68%
14. Cincinnati Bell Telephone Co	11.49%	10.87%
15. Continental Telephone Co. of California	13.67%	12.20%
16. Continental Telephone Co. of Illinois	10.03%	11.42%
17. Continental Telephone Co. of Missouri	17.38%	N/A
18. Continental Telephone Co. of New York	9.56%	10.90%
19. Continental Telephone Co. of Virginia	11.91%	10.50%
20. Contel of Texas, Inc	11.49%	11.54%
21. Diamond State Telephone Co	12.06%	10.88%
22. GTE California, Inc	10.91%	10.05%
23. GTE Florida, Inc	10.98%	10.84%
24. GTE Hawaiian Telephone Co., Inc	10.28%	9.29%
25. GTE North, Inc	19.96%	N/A
26. GTE Northwest	9.48%	9.72%
27. GTE South, Inc	8.84%	9.55%
28. GTE Southwest, Inc	9.41%	10.29%
29. Illinois Bell Telephone Co	10.35%	10.26%
30. Indiana Bell Telephoone Co	9.54%	10.24%
31. Lincoln Telephone & Telegraph Co	10.80%	10.24%
32. Michigan Bell Telephone Co	8.54%	8.48%
33. Mountain States Telephone & Telegraph Co	8.98%	9.33%
34. Nevada Bell	11.14%	12.35%
35. New England Telephone and Telegraph Co	9.78%	9.66%
36. New Jersey Bell Telephone Co	9.99%	11.11%

Rate of Return on Utility Rate Base for Selected Telephone Carriers
Continued

Telephone Carriers	Rate of Return 1/	
	1987	1986
37. New York Telephone Co	10.09%	10.83%
38. Northwestern Bell	9.26%	9.28%
39. Ohio Bell Telephone Co	8.23%	8.81%
40. Pacific Bell	8.86%	9.04%
41. Pacific Northwest Bell	9.61%	8.75%
42. Puerto Rico Telephone Co	14.76%	17.12%
43. Rochester Telephone Corporation	10.22%	10.89%
44. South Central Bell Telephone Co	10.18%	9.71%
45. Southern Bell Telephone & Telegraph Co	10.65%	10.71%
46. Southern New England Telephone Co	9.90%	10.52%
47. Southwestern Bell Telephone Co	8.64%	7.84%
48. United Inter-Mountain Telephone Co	11.03%	10.89%
49. United Telephone Co. of Florida	10.61%	11.20%
50. United Telephone Co. of Indiana	10.88%	9.98%
51. United Telephone Co. of Missouri	10.47%	11.00%
52. United Telephone Co. of Ohio	10.41%	10.58%
53. United Telephone Co. of Pennsylvania	10.31%	9.03%
54. Wisconsin Bell, Inc	9.27%	8.18%

Note--This table presents rates of return on utility rate bases for subject and selected large non-subject telephone carriers. The calculations, with minor modifications, were made according to principles employed by the Federal Communications Commission for regulatory purposes. The rate base is the average of beginning and end-of-year net plant (on an original book value basis including plant under construction). Return is defined as net operating income after taxes plus interest during construction.

1/ In many states the statutory rate base differs from that used in the present calculations. The allowance for income taxes differs among the various jurisdictions as does the treatment of certain other items (e.g., working capital, and materials and supplies, which are omitted in the above calculations). Furthermore, since there is no generally accepted allowable rate of return, some of the variability in rates of return among companies is due to jurisdictional differences. For these reasons, the above rate of return statistics are intended for use only as trend indicators and not for use in evaluation of company performance or reasonableness of earnings.

Source: Federal Communications Commission.

Table 27
Selected Averages and Ratio of All Local Exchange Carriers as of December 31, 1987

Item	Amount or Percent
Book Cost of Communication Plant:	
Gross Book Cost Per Company Access Line	$1,786.92
Net Book Cost Per Company Access Line	$1,232.91
Ratio of Operating Revenues to Average Net Book Cost of Communication Plant	52.71%
Ratio of Depreciation and Amortization Reserves to Gross Book Cost of Communication Plant	31.00%
Ratio of Interest on Funded Debt to Net Operating Income After Taxes	26.80%
Total Local Service Revenues Per Company Access Line	$293.59
Total Toll Service Revenues Per Company Access Line	$104.50
Operating Revenues Per Company Access Line	$642.98
Operating Expenses Per Company Access Line	$432.33
Ratio of Operating Expenses to Operating Revenues	67.24%
Ratio of Traffic Expenses to Total Operating Expenses	4.69%
Ratio of Maintencance Expenses to Total Operating Expenses	28.31%
Ratio of Maintenance Expenses to Average Gross Book Cost of Communication Plant	7.08%
Depreciation and Amortization Expenses:	
Ratio to Average Gross Book Cost of Communication Plant	7.96%
Ratio to Operating Revenues	21.40%
Ratio to Operating Expenses (Including Depreciation and Amortization)	31.82%
Taxes:	
Ratio to Operating Revenues	14.64%
Ratio to Operating Expenses and Taxes	17.88%
Net Operating Income (After All Taxes):	
Ratio to Average Net Book Cost of Communication Plant	9.55%
Ratio to Operating Revenues	18.12%
Ratio of Net Income to Equity Capital	16.03%
Wire Mileage:	
Percent of Wire in Cable	99.94%
Percent of Aerial Wire	0.06%

Source: Federal Communication Commission

Table 28
Value of Plant and Equipment of all Local Exchange Carriers
As of December 31, 1987

Account	Balance at Beginning of Year	Plant Added	Plant Retired	Transfers and Adjustments	Balance at End of Year
			Dollars		
Communication Plant in Service:					
Organization	1,023,771	0	22,790	0	1,000,981
Franchises	2,178,781	1,399,133	0	0	3,577,914
Patent Rights	74,117	0	0	0	74,117
Land	1,062,641,657	25,249,112	6,779,160	(5,641)	1,081,105,968
Buildings	15,721,934,504	789,006,271	133,305,375	2,739,765	16,380,375,164
Central Office Equipment	71,694,958,111	9,537,129,671	5,108,667,658	35,987,124	76,159,407,248
Station Apparatus	1,586,676,958	29,713,956	463,508,637	(44,290,341)	1,108,591,936
Station Connections	14,305,173,290	35,200,564	104,164,290	293,101,077	14,529,310,641
Large Private Branch Exchanges	1,573,474,407	196,002,400	196,832,031	(13,886,238)	1,558,758,538
Public Telephone Equipment	1,280,489,246	154,109,026	105,000,740	(1,662,236)	1,327,935,296
Pole Lines	3,903,714,663	269,909,730	68,520,375	(163,583)	4,104,940,435
Aerial Cable	20,458,329,255	1,579,022,497	343,325,403	(282,270,956)	21,411,755,393
Underground Cable	16,542,278,325	1,080,795,076	127,452,125	(118,285)	17,495,502,991
Buried Cable	26,962,866,879	2,280,355,966	270,173,201	(9,326,872)	28,963,722,773
Submarine Cable	134,806,083	4,301,319	4,585,895	(14,717)	134,506,790
Aerial Wire	339,026,897	18,143,496	14,656,367	(15,343,082)	327,170,944
Underground Conduit	10,596,588,228	531,763,297	15,779,360	10,610	11,112,582,775
Furniture and Office Equipment	6,820,223,157	1,189,161,269	422,302,851	34,274,303	7,621,355,878
Other Communications Equipment	2,543,585,447	404,243,066	247,564,297	(31,125,529)	2,669,138,689
Vehicles and other Work Equipment	3,533,278,397	409,769,926	252,873,077	5,867,108	3,696,042,354
Telephone Plant Acquired	79,400	(78,394)	0	(358)	648
Telephone Plant Sold	0	0	0	0	0
Total Communication Plant in Service	199,063,401,575	18,535,197,381	7,885,513,632	(26,227,851)	209,686,857,473
Telephone Plant Under Construction	4,601,509,089	769,811,741	981,114,164	(10,165,537)	4,380,041,129
Property Held for Future Telephone Use	22,985,860	8,225,366	1,838,794	307,002	29,679,434
Telephone Plant Acquisition Adjustment	22,209,709	(27,411)	472,771	(726,401)	20,983,126
Satellite Earth Stations	7,994,103	10,914	235,903	0	7,769,114
Total Communication Plant--Gross	203,718,100,335	19,313,217,992	8,869,175,264	(36,812,787)	214,125,330,277

Source: Federal Communications Commission

INTEREXCHANGE MARKET

The market for long distance (interexchange) services has been radically changed by competition. AT&T was the only long distance carrier until 1969 when the FCC authorized MCI to provide specialized long distance service. Since then, over 500 companies have sprung up to provide private or common-carrier interexhange voice and/or data services. Most of these companies resell capacity of larger carriers and serve small niche markets. While international long distance is large and growing rapidly, this study concentrates on domestic interexchange service.

The market has spurred significant development in transmission media, such as satellite, microwave, and fiber optics. The thrust of these technologies has been to increase the capacity and cost efficiencies of the networks, to become more competitive in the marketplace. Consumers have benefited greatly by these initiatives as average long distance rates have plummeted.

The interexchange telecommunications services market (excluding intra-LATA, long distance service provided by local exchange companies within their own territory) amounted to $45.2 billion in 1987, up from $32.5 billion in 1985 (see Table 29). Three carriers--AT&T, MCI and U.S. Sprint--have almost 93 percent of the market (see Fig. 10). The total number of toll calls (includes intra-LATA toll calls as well as calls made through interexchange carriers like AT&T, MCI, etc) made in 1987 amounted to 53 billion. AT&T Communications, by far the largest carrier, had interexchange revenues of $35.2 billion in 1987, up from $27.5 billion in 1985. However, AT&T's share decreased from 84.6 percent in 1985 to 77.9 percent in 1987. MCI had interexchange revenues of $3.9 billion in 1987, up from $2.5 billion in 1985. Its share increased from 7.6 percent in 1985 to 8.7 percent in 1986 before decreasing slightly in 1987. U.S. Sprint's interexchange revenues increased from $1.2 billion in 1985 (3.6 percent of the total) to $2.8 billion in 1987 (6.2 percent of the total). Other interexchange carriers such as Alltel and NTN (a consortium of five regional networks) are beginning to take market share away from the larger carriers, especially AT&T.

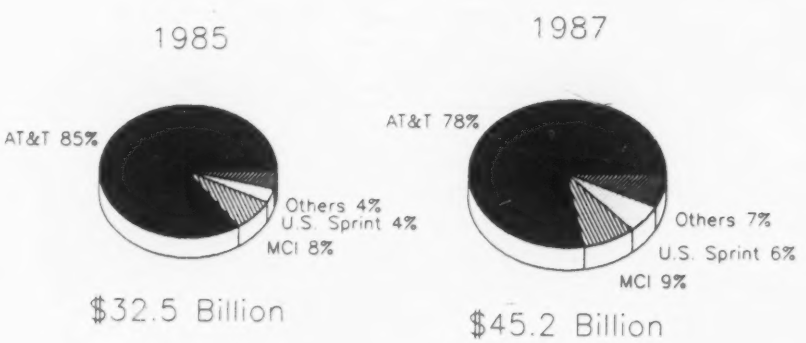
Seeking to capture a greater market share in the robust interexchange market, many of the competitors are expanding or upgrading their networks. One way they have done that is by installing fiber optic networks to increase capacity, reduce installation and maintenance costs, and increase network performance. At year-end 1987, AT&T had 456,000 miles of fiber optic cable, U.S. Sprint had 323,000 miles, MCI had 224,000 miles, NTN had 156,000 miles, and Lightnet had 127,000 miles. Similar information for other carriers is unavailable.

AT&T announced it would spend $2.5 billion on digital network expansion in 1987 and comparable amounts in 1988 and 1989. AT&T now provides 215 U.S. cities with digital service and 98 percent of its calls are switched digitally. The AT&T digital network now covers 32,000 miles and will expand to 53,000 miles by 1990; the current 11,000 miles of high-speed optical fiber will increase to 24,000 miles.

AT&T Communications had a total value of $23.7 billion in plant and equipment in 1987 (see Table 30). Of that, 67 percent or $16 billion was in central office equipment. Other significant segments were buildings at $3 billion and cable at $2 billion.

MCI concluded a venture with Shared Network Technologies in 1987, strengthening its position as the number two interexchange carrier. Almost half of MCI's circuit lines and 90 percent of its access ports are now digital. U.S. Sprint's digital network will be on line by the end of this year.

Figure 10.--Interexchange Market, 1985 and 1987



Source: Estimated by the NATA Market Research Dept. based on industry sources

Table 29
Interexchange Revenues* and Market Shares
of Major Service Providers, 1985-1987

	1985	1986	1987
	--billions of dollars--		
AT&T	27.5	32.3	35.2
MCI	2.5	3.6	3.9
U.S. Sprint	1.2	2.6	2.8
Others	1.3	2.9	3.3
Total	32.5	41.4	45.2
	--percent of total--		
AT&T	84.6	78.1	77.9
MCI	7.6	8.7	8.6
U.S. Sprint	3.6	6.2	6.2
Others	4.1	7.0	7.3
Total	100.0	100.0	100.0

* Excludes Local Exchange Carriers

Source: Estimated by the NATA Market Research Department, based on industry sources

Table 30
Value of Plant and Equipment of AT&T Communications, Inc.
As of December 31, 1987

Account	Balance at Beginning of Year	Plant Added	Plant Retired	Transfers and Adjustments	Balance at End of Year
Communication Plant in Service:					
Land	118,642,659	6,399,882	1,568,070	4,464	123,478,935
Buildings	2,710,260,007	169,717,916	26,558,834	0	2,853,419,089
Central Office Equipment	15,018,121,624	1,798,579,686	958,573,458	0	15,858,127,852
Large Private Branch Exchanges	13,854,780	(1,810,346)	43,535	0	12,000,899
Public Telephone Equipment	58,913,609	24,668,938	3,827,383	0	79,755,164
Pole Lines	18,201,979	669,382	247,549	0	18,623,812
Aerial Cable	7,325,996	274,767	881,053	0	6,719,710
Underground Cable	280,620,596	47,254,022	7,053,460	0	320,821,158
Buried Cable	1,144,346,118	288,331,452	20,896,696	0	1,411,780,874
Submarine Cable	290,755,650	10,145,829	21,884,057	0	279,017,422
Aerial Wire	2,068,425	24,883	19,892	0	2,073,416
Underground Conduit	86,850,555	59,989,412	70,632	0	146,769,335
Furniture and Office Equipment	386,947,418	74,759,097	29,617,138	0	432,089,377
Other Communications Equipment	134,465,665	8,587,376	(12,004)	0	143,065,045
Vehicles and Other Work Equipment	66,546,217	10,362,290	6,763,809	0	70,144,698
Telephone Plant Acquired	197,751	(197,751)	0	0	0
Total Communication Plant in Service	20,338,119,049	2,497,756,835	1,077,993,562	4,464	21,757,886,786
Telephone Plant Under Construction	1,499,613,893	221,405,240	3,663,294	0	1,717,355,839
Property Held for Future Telephone Use	727,938	190,592	(2,445,106)	0	3,363,636
Telephone Plant Acquisition Adjustment	(2,089,964)	8,437,547	0	(4,464)	6,343,119
Satellite Earth Stations	131,221,441	111,748,542	12,795,078	0	230,174,905
Total Communication Plant--Gross	21,967,592,357	2,839,538,756	1,092,006,828	0	23,715,124,285

Source: Federal Communications Commission

INFORMATION BY STATE

Overall in the United States, 93 percent of all households had telephone service as of March 1988, up slightly from a year earlier (see Table 31). Massachusetts and Minnesota had the highest percentages, both with 97.3 percent penetration, while Arkansas had the lowest with 83.6 percent.

In 1987, California had the greatest number of total access lines with 16 million, of which 5 million were business, 10 million were residential, and a small percentatge for pay phones (see Table 32). New York had the second largest number of access lines at 10 million--3 million business, 7 million residential, and the balance for pay phones. Other large states, in terms of access lines, included Texas with 8 million, Florida with 7 million, Illinois with 6 million, and Ohio, New Jersey and Michigan--all with about 5 million.

In 1987, a total of 62 million telephone calls were placed in California. Of those, 49 million were local calls, and 13 million were toll calls (see Table 33). New York was second with over 35 million calls--32 million local and 4 million toll. Texas was third with over 32 million calls--28 million local and 5 million toll.

Table 31
Telephone Development by States

State	Percent of Households with Telephone Service			
	March 1987	July 1987	November 1987	March 1988
United States.....	92.5	92.3	92.3	92.9
Alabama.....	87.2	86.3	88.9	88.4
Alaska.....	88.3	87.4	87.8	87.2
Arizona.....	89.1	88.6	88.2	90.5
Arkansas.....	87.0	85.8	86.0	83.6
California.....	94.3	93.2	93.8	94.7
Colorado.....	93.2	93.0	92.5	95.1
Connecticut.....	97.9	96.7	96.4	96.5
Delaware.....	96.5	96.9	96.1	97.2
Dist. of Columbia.	91.2	92.1	94.0	93.3
Florida.....	91.2	92.3	91.7	93.0
Georgia.....	87.5	89.2	89.5	91.5
Hawaii.....	94.8	94.8	93.1	95.3
Idaho.....	90.9	90.4	92.0	92.9
Illinois.....	94.0	93.3	93.7	94.3
Indiana.....	91.3	91.0	91.4	91.4
Iowa.....	95.5	94.9	94.8	94.5
Kansas.....	95.5	95.2	94.9	95.3
Kentucky.....	87.4	85.0	87.2	89.5
Louisiana.....	86.9	89.5	86.1	86.8
Maine.....	94.2	93.1	93.1	94.3
Maryland.....	96.2	94.2	96.0	96.4
Massachusetts.....	96.7	97.0	95.5	97.3
Michigan.....	94.1	93.3	93.7	94.4
Minnesota.....	95.8	96.0	96.1	97.3
Mississippi.....	82.6	79.8	81.9	83.8
Missouri.....	91.5	93.5	94.0	93.0
Montana.....	91.4	89.3	91.9	91.4
Nebraska.....	95.0	95.1	93.8	96.4
Nevada.....	92.1	92.5	92.5	91.8
New Hampshire.....	94.0	94.8	93.6	96.5
New Jersey.....	94.3	95.6	95.2	94.3
New Mexico.....	89.1	83.6	85.5	85.9
New York.....	93.3	92.5	92.5	93.0
North Carolina....	89.7	89.5	88.5	90.1
North Dakota.....	97.8	96.1	96.4	96.7
Ohio.....	93.4	93.9	92.9	94.0
Oklahoma.....	88.5	89.1	88.6	89.6
Oregon.....	91.1	94.5	94.3	89.4
Pennsylvania.....	96.0	97.0	96.1	96.1
Rhode Island.....	95.1	95.0	95.6	95.4
South Carolina....	89.0	85.6	88.5	88.3
South Dakota.....	92.2	93.3	92.8	92.2
Tennessee.....	89.3	89.1	89.2	91.7
Texas.....	90.4	89.5	88.6	87.8
Utah.....	93.2	90.1	93.7	93.0
Vermont.....	95.8	95.4	94.8	95.9
Virginia.....	92.9	92.7	91.9	94.7
Washington.....	93.2	94.5	95.1	93.4
West Virginia.....	88.7	88.1	86.7	87.9
Wisconsin.....	96.2	95.5	97.5	95.9
Wyoming.....	93.3	93.5	90.1	93.6

Note: Compiled by U.S. Department of Commerce, Bureau of the Census, per agreement with the Federal Communications Commission.

Table 32
Selected Data Shown by States, or Other Areas, of Telephone Carriers
as of Dec. 31, 1987

State or Other Area	Company Access Lines							
	Total	By Type of Access Line				By Type of Customer		
		Main	PBX & Centrex	Other Switched	Special	Business	Coin	Residence
Alabama	1,487,235	1,381,915	79,794	20,810	4,716	321,179	22,938	1,143,118
Alaska	114,088	112,107	1,745	0	236	39,209	1,732	73,147
Arizona	1,667,046	1,516,058	110,325	23,045	17,618	447,559	22,468	1,197,019
Arkansas	750,244	700,255	28,010	11,079	10,900	176,576	14,201	559,467
California	15,874,086	13,695,526	1,495,881	284,963	397,716	5,360,524	221,579	10,291,983
Colorado	1,784,215	1,608,339	120,802	31,939	23,135	526,429	23,316	1,234,470
Connecticut	1,816,457	1,524,683	108,561	182,940	273	513,400	25,548	1,277,509
Delaware	388,717	306,845	62,634	8,756	10,482	132,658	4,798	251,261
Dist. of Columbia	872,623	414,488	361,840	15,705	80,590	576,545	10,077	286,001
Florida	6,639,811	6,198,756	309,480	88,334	42,241	1,624,301	92,284	4,923,226
Georgia	2,688,781	2,393,123	217,359	68,930	9,369	775,312	40,990	1,872,479
Hawaii	512,681	202,436	303,605	435	6,205	141,956	6,774	363,951
Idaho	416,592	376,257	31,559	5,754	3,022	104,940	5,167	306,485
Illinois	5,924,481	4,884,587	623,465	133,495	114,778	1,850,621	86,137	3,987,723
Indiana	2,287,041	1,995,575	165,525	68,462	57,479	565,425	33,157	1,688,459
Iowa	1,038,467	947,821	52,026	19,434	19,186	248,507	11,430	778,530
Kansas	1,014,963	933,704	52,513	14,458	14,288	263,792	16,815	734,356
Kentucky	1,325,936	1,243,639	55,901	13,244	13,152	277,692	21,121	1,027,123
Louisiana	1,747,309	1,607,395	109,325	21,351	9,238	403,548	28,349	1,315,412
Maine	515,247	481,893	29,881	0	3,473	107,742	6,989	400,516
Maryland	2,627,707	2,219,354	303,308	32,400	72,645	818,378	35,382	1,773,947
Massachusetts	3,429,742	3,023,684	364,383	0	41,675	925,980	58,460	2,445,302
Michigan	4,524,376	3,917,527	435,062	88,509	83,278	1,266,817	61,239	3,196,320
Minnesota	1,764,720	1,507,538	193,897	35,652	27,633	507,914	16,176	1,240,630
Mississippi	913,025	855,651	43,611	9,692	4,071	192,941	15,749	704,335
Missouri	2,348,741	2,150,148	129,678	29,274	39,641	580,777	37,045	1,730,919
Montana	307,782	287,825	11,285	6,504	2,168	72,803	4,903	230,076
Nebraska	698,872	621,085	51,748	14,522	11,517	180,657	8,645	509,570
Nevada	570,626	530,809	23,139	8,052	8,626	162,808	7,321	400,497
New Hampshire	550,968	503,315	42,520	0	5,133	133,504	8,198	409,266
New Jersey	4,656,927	4,020,254	366,768	99,885	170,020	1,451,005	78,194	3,127,728
New Mexico	584,856	529,355	41,742	8,125	5,634	154,949	7,538	422,369
New York	10,119,357	8,295,009	1,121,108	124	202,702	3,156,444	150,173	6,812,740
North Carolina	2,546,596	2,288,367	187,130	56,797	14,302	612,631	31,566	1,902,399
North Dakota	251,564	227,047	16,046	4,831	3,640	62,989	3,246	185,329
Ohio	4,820,284	4,320,752	319,894	113,172	66,466	1,171,161	70,558	3,578,565
Oklahoma	1,361,968	1,264,423	66,732	13,431	17,382	351,580	23,156	987,232
Oregon	1,212,067	1,061,839	110,420	19,911	19,897	326,018	15,751	870,298
Pennsylvania	5,672,410	4,869,439	543,059	118,263	141,204	1,603,931	74,282	3,994,197
Rhode Island	504,992	472,070	28,103	0	4,819	106,472	7,940	390,580
South Carolina	1,106,121	1,020,023	62,003	18,022	6,073	261,663	18,121	826,337
South Dakota	248,562	228,114	12,199	4,897	3,352	59,009	3,665	185,888
Tennessee	2,066,234	1,885,671	136,776	32,405	11,382	486,993	29,562	1,549,679
Texas	7,627,019	6,899,612	482,324	70,952	174,131	2,255,363	128,623	5,243,033
Utah	679,044	605,543	55,057	12,364	6,080	186,631	8,375	484,038
Vermont	244,317	227,263	14,946	0	2,108	56,973	3,950	183,394
Virginia	2,953,444	2,562,096	337,143	51,171	85,348	882,351	38,861	2,032,232
Washington	2,226,650	1,896,913	266,856	30,475	32,406	638,290	25,282	1,563,078
West Virginia	729,632	669,064	36,856	7,953	15,759	155,631	9,383	564,618
Wisconsin	1,971,554	1,722,806	174,548	44,848	29,352	502,351	26,630	1,442,573
Wyoming	214,485	193,596	16,136	3,196	1,557	62,541	3,683	148,261
United States	118,400,662	103,401,594	10,314,708	1,949,561	2,148,098	33,845,470	1,707,527	82,847,665
Puerto Rico	696,066	656,291	23,191	16,584	0	146,799	12,851	536,416
Vigin Islands	0	0	0	0	0	0	0	0
Ocean Cable	0	0	0	0	0	0	0	0
Grand Total	119,096,728	104,057,885	10,337,899	1,966,145	2,148,098	33,992,269	1,720,378	83,384,081

Source: Federal Communications Commission

Table 33
Selected Data Shown by States, or Other Areas, of Telephone Carriers as of December 31, 1987

State or Other Area	Miles of Wire in Cable	Miles of Aerial Wire	Miles of Tube in Coaxial Cable	Miles of Radio Relay System	Central Office Switches	Number of Calls 1/	
						Local	Toll
Alabama	22,783,692	19,909	113	4,398	185	5,993,040,039	693,859,715
Alaska	1,092,498	0	299	8,310	11	547,358,260	28,972,263
Arizona	23,640,587	13,451	7,070	3,463	165	5,701,030,735	129,641,985
Arkansas	10,813,636	17,658	502	2,920	194	2,372,926,273	424,873,336
California	181,846,707	72,051	22,210	11,528	998	49,068,531,258	12,689,986,352
Colorado	23,142,494	25,498	5,253	7,817	210	5,711,343,727	216,878,564
Connecticut	20,553,753	60	4,627	1,270	441	5,162,642,421	1,288,429,679
Delaware	4,518,227	612	434	184	34	1,059,702,944	61,827,369
Dist. of Columbia	6,122,194	0	56	21	28	3,136,268,883	3,560,578
Florida	85,741,315	12,272	11,352	7,871	427	21,288,125,043	3,126,443,149
Georgia	39,452,469	58,797	10,072	3,710	266	10,771,792,422	1,386,687,204
Hawaii	3,365,096	8,960	420	4,567	82	2,414,361,299	137,712,027
Idaho	5,414,655	3,830	41	2,501	115	1,129,760,921	104,372,835
Illinois	61,032,409	12,717	16,585	5,167	785	17,887,457,844	2,165,507,408
Indiana	26,411,975	18,043	12,595	3,901	390	7,769,855,945	907,821,717
Iowa	12,740,250	1,345	8,184	6,085	326	2,628,719,998	228,595,035
Kansas	12,402,277	3,281	5,420	3,873	179	2,966,364,833	543,089,830
Kentucky	18,400,037	29,117	1,376	2,566	261	4,565,420,795	566,464,584
Louisiana	28,698,165	3,308	1,240	2,389	228	7,749,000,000	832,491,873
Maine	6,241,221	15,828	61	638	140	1,130,000,000	313,139,913
Maryland	30,353,923	0	4,742	1,424	228	9,131,058,593	158,930,644
Massachusetts	37,875,501	7,683	4,985	734	283	9,713,000,000	2,543,850,882
Michigan	59,420,589	13,527	1,675	3,610	555	14,574,876,017	2,263,631,262
Minnesota	23,472,731	3,024	1,143	4,956	243	5,290,369,645	159,063,680
Mississippi	14,972,157	13,678	3,352	3,121	200	3,663,000,000	488,846,200
Missouri	28,657,839	14,274	4,217	7,247	492	7,704,815,688	1,034,174,997
Montana	3,624,835	9,386	34	3,295	136	822,658,126	64,620,833
Nebraska	8,774,908	814	10,989	4,516	278	2,071,813,219	136,934,276
Nevada	6,694,521	15,227	7,874	4,879	77	1,872,352,178	427,549,054
New Hampshire	7,421,577	7,125	62	291	130	1,186,000,000	447,019,772
New Jersey	50,667,539	0	9,753	2,141	210	11,276,791,420	2,732,621,020
New Mexico	6,970,686	5,416	5,304	3,513	77	1,814,912,090	90,306,422
New York	104,644,497	67,158	14,330	5,924	862	31,588,285,048	3,554,304,858
North Carolina	35,713,843	30,370	6,259	5,876	418	7,815,836,495	1,385,480,900
North Dakota	3,734,834	177	4	5,341	105	643,310,893	42,892,250
Ohio	52,251,085	32,543	23,472	5,267	784	15,985,429,134	1,031,745,630
Oklahoma	19,754,755	12,573	1,227	3,946	279	4,211,894,028	655,293,603
Oregon	14,126,315	29,731	2,002	3,630	152	3,394,360,449	298,963,687
Pennsylvania	56,408,332	36,533	12,265	5,836	589	16,709,427,550	1,316,495,657
Rhode Island	5,998,284	2,661	493	33	33	1,599,000,000	278,722,877
South Carolina	17,297,439	9,042	3,270	1,262	155	4,202,611,755	533,628,712
South Dakota	3,705,444	428	332	5,179	107	578,826,157	52,418,268
Tennessee	28,637,124	42,530	174	3,267	240	8,297,256,853	945,635,033
Texas	115,686,513	75,607	6,115	9,401	1,069	27,629,498,937	4,759,833,018
Utah	8,620,323	4,735	5,044	2,272	99	2,560,747,310	127,207,278
Vermont	3,205,966	12,045	25	297	98	527,000,000	162,293,233
Virginia	39,754,526	19,440	8,020	3,963	386	9,911,519,319	512,477,712
Washington	26,485,543	34,697	753	3,673	226	6,568,203,410	585,317,333
West Virginia	9,701,703	1,307	2,978	1,993	181	2,214,607,969	163,901,743
Wisconsin	23,140,084	15,078	1,158	4,155	327	5,484,958,672	370,160,333
Wyoming	3,507,819	1,954	10,288	4,190	58	533,903,170	40,395,253
United States	1,445,694,892	835,498	260,250	198,411	14,542	378,632,027,765	53,215,071,836
Puerto Rico	7,089,019	15,353	101	250	126	1,232,236,279	0
Virgin Islands	7,979	0	0	0	0	0	0
Ocean Cable	0	0	19,511	0	0	0	0
Grand Total	1,452,791,890	850,851	279,862	198,661	14,668	379,864,264,044	53,215,071,836

Source: Annual reports of all reporting Carriers.
1/ Partly estimated. Some carriers do not include toll calls passed on to interexchange carrier.

INFORMATION SERVICES MARKET

The market for information services is the result of the growing integration of communication and computer products and services. This integration is evolving not only because of the merging of technologies, but because of the merging of applications as well. Access to information has been identified as one of the most significant factors contributing to the nation's productivity. The information services market becomes important in that regard by maintaining the U.S. industrial vitality and competitive position.

Information services can generally be categorized into seven categories, not necessarily exclusive of each other. They are videotex services, access and retrieval services, messaging services, transactional services, personal and environmental management, computing services, and code and protocol conversion. The one that will likely have the most impact in the marketplace is videotex. Videotex is defined as a group of information services delivered via telecommunications networks and displayed on a video terminal.

Online databases and interactive services have experienced significant growth in the 1980s especially in the business sector. According to the Department of Commerce, 3,369 databases were available via 528 online services in 1987, compared to only 400 databases available via 59 online services in the 1979-80 period. Table 34 lists most of the major U.S. database providers up and running as of January 1, 1988. Each provider may support several different databases, and each database may be supplied by a variety of online services. Revenues generated from the business online databases have been estimated at $5 billion in 1987 with expections of $15 billion by 1992. Table 35 lists major current providers of electronic mail.

One recent important development that is likely to spur this market is the recent decision to allow telephone companies to provide gateway services. In this context, a gateway is a service that permits users to access various information sources offered by other vendors by initially accessing only a single vendor. The first vendor, for all practical purposes, provides a transparency to the user, by allowing access to many databases through one account.

While the decision to allow telephones companies to participate in the information services market by providing gateways is considered by some to lend legitimacy to the industry, there is concern that the industry may become overly concentrated due to the extensive resources available to the telephone companies. If fair competition is assured, the information services market is likely to become one of the next hot spots of the telecommunications industry.

Table 34
U.S. Information Service Subscribership as of January 1, 1988

Company	Service	Subscribers Jan. 1, 1987	Subscribers Jan. 1, 1988
CompuServe	CompuServe Info. Services	340,000	400,000
Dow Jones	Dow Jones News/Retrieval	240,000	285,000
British Telecom/Dialcom	Dialcom	200,000	250,000
Mead Data Control	LEXIS/NEXIS/MEDIS	200,000	205,000
Wester Union	EasyLink	156,625	175,000
Reuters	Monitor	108,368	135,000
CitiCorp/Quotron	Financial Information Services	85,950	95,759
Dialog Information Services	Dialog	70,000	86,000
GEISCO	Genie	37,000	85,000
Source Telecomputing	The Source	55,000	70,000
ADP/Bunker Ramo	Financial Information Services	65,000	65,000
TRW	Credit Data Service	59,936	64,100
American Airlines	SABRE	51,905	62,900
United Airlines	Apollo	38,000	57,000
General Videotex	Delphi	45,000	55,000
BRS	BRS	43,893	54,200
Telerate	Telerate	45,000	52,000
Dun & Bradstreet	Dun Sprint	32,000	48,000
Equifax	Financial Control Service	40,000	47,000
Chilton	Chilton Credit Reporting	42,701	46,000
Official Airline Guide	OAG Electronic Edition	29,000	35,600
Texas Air	Systetm One Direct Access	17,475	25,000
TWA/Northwest Airlines	PARS	15,300	20,948
PRC Realty	Multiple Listing Service	14,155	20,000
Knight Ridder	K-R Financial Information	11,500	18,500
News Net	News Net	14,000	15,250
United Press International	UPI	15,000	13,500
Delta	Datas Link	9,400	12,200
Telerate/CMQ Comm.	Auto Quote	8,000	10,500
OCLC Inc.	ACLC	7,623	8,146
Info Globe	Info Globe	6,700	8,100
Reuters/I.P. Sharp	I.P. Sharp Online	6,300	6,600
Knight Ridder	VU/Text	3,700	4,900
Datatek	Data Times	3,500	4,300
Business Wire	Business Wire	1,050	1,300
FastFinder	FastFinder	170	345
Comtex Scientific	Newsgrid	16	20

Source: U.S. Department of Commerce

Table 35
Major Public Electronic Mail Services

Service	Mailboxes	Messages per Month
Dialcom (British Telecom)	120,000	1,500,000
EasyPlex (CompuServe)	330,000	1,100,000
Quik-Comm (General Electric)	70,000	1,500,000
On Tyme (McDonnell Douglas)	60,000	1,300,000
MCI Mail	90,000	1,800,000
The Source	65,000	1,400,000
Telemail (US Sprint)	100,000	2,200,000
Easylink (Western Union)	175,000	9,000,000

Source: U.S. Department of Commerce

CHAPTER VI

SELECTED MARKETS

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SELECTED MARKETS

PBX-CENTREX MARKET

Introduction

Private branch exchanges (PBXs) are multi-line business telephone systems providing users with pooled access to a group of external telephone access lines provided by the local telephone company's central office. PBX systems provide, essentially, the same services as a telephone company central office--dial tone signaling and call routing--but on a much smaller scale and typically from equipment located on a customer's premises. A PBX is often referred to as a switch because, like a central office, it automatically establishes and routes (or switches) calls between the various stations on a user's premises or between an on-premise extension and the public switched network. A distinguishing characteristic of PBX systems is the users' pooled access to outside CO lines. When a user dials "9" or another designated code from an extension, the switch automatically seizes an idle outside line from a pool of available CO lines to complete the call.

In general, PBXs are being equipped with more and more features such as integrated call distributors, cost accounting and voice messaging as well as the ability to bridge local area networks and have full data communications capability. Digital PBXs are replacing analog PBXs, which themselves, replaced the old electromechanical types not too many years ago. Several manufacturers have recently announced ISDN compatible PBXs. Even though ISDN is several years away from commercial implementation, manufacturers want to sell PBXs today that will be forward compatible.

"Centrex" is the generic name for a subscriber switching service offered by local telephone companies to business customers. Centrex service provides business with PBX-like features and capabilities directly from the central office, rather than through premises-based PBX equipment. That is, centrex service is provided from the same local switching center that provides business and residential customers alike with dial tone, local call-routing, and access to long distance networks. In order to provide centrex, the local telephone company dedicates lines and a portion of the CO switch to an individual customer.

Typically, centrex service consists of two elements: local-exchange access and switching and intercom service with a package of call-processing features similar to those available from PBX systems. Centrex has generally been treated as a regulated service, and prices are usually set in tariffs approved by state regulators. There is a growing trend however, both to allow flexible tariffing of centrex, somethimes including customized service packages to larger customers where the actual price of the centrex service itself, is not revealed; and to deregulate centrex service completely. In any event, centrex prices tend to vary from state to state.

Three types of CO switches, distinguished by the technologies they embody, currently provide centrex service in various parts of the country: electromechanical, stored program-controlled electronic, and digital.

Prior to the Bell System breakup, centrex--confined primarily to the very large business market--was declining in the market, the result of a deliberate effort by AT&T. Since divestiture, however, the RBOCs have moved aggressively to rejuvenate and promote centrex services, especially in urban markets. To increase the service's appeal to businesses, the RBOCs have fought for and won, deep centrex rate reductions--as well as enhanced feature offerings and lowered minimum line-size restrictions--from state regulators.

Centrex services are currently distributed through three channels: the telephone companies' own sales force, authorized third party sales agents that get commissions from the telephone companies, and thirdly, in some cases, by companies that want to sell CPE that is used with centrex services will market centrex and arrange for the installation, but not receive any commissions for the sale. At the urging of NATA, the FCC has established the authorized sales agency program as an essential safeguard and precondition to relief for the BOCs from certain regulatory restrictions.

Market Review

Total annual PBX line sales have grown rather slowly over the past several years from 3.8 million lines in 1984 to 4.2 million lines in 1987 and is expected to increase to 4.5 million by 1990 (see Table 36 and Fig. 11). In terms of systems, annual shipments increased from 25 thousand valued at $2.8 billion in 1984 to 28 thousand valued at $3.1 billion in 1988. System sales are expected to amount to 30 thousand valued at $3.2 billion in 1990.

In an attempt to shore up sales, manufacturers have been buying up interconnect companies in recent years. Manufacturer direct sales (including sales through wholly owned subsidiaries) increased from 50.4 percent of the market in 1986 to 53.7 percent in 1987 (see Table 37). Sales by independent interconnects increased slightly from 24.1 percent to 25 percent (see Fig. 12). Wholesale houses lost ground from 9.7 percent to 5.4 percent while the RBOCs' share went from 11.6 percent to 12.4 percent. The share of the total by independent telephone companies decreased from 4.2 percent to 3.5 percent.

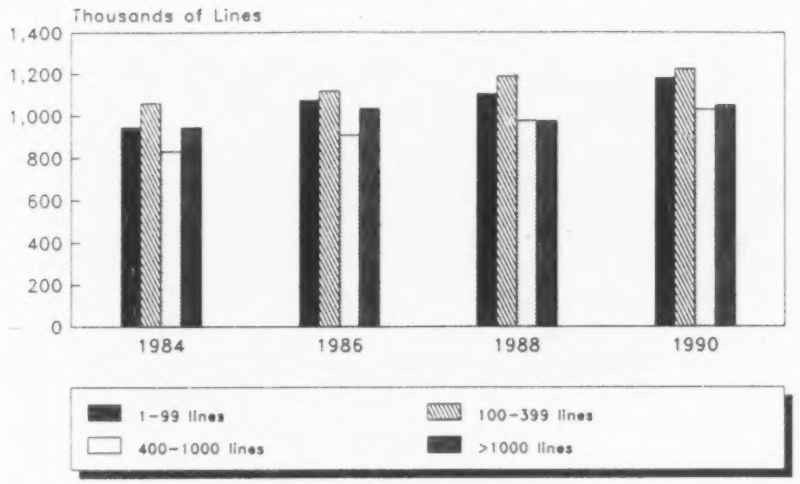
PBX-Centrex Installed Base

The total installed base of PBXs increased from 22 million lines in 1984 to 25 million in 1987 and is expected to increase slightly in 1988 to 26 million lines but fall back to 25 million by 1990 (see Table 38 and Fig. 13). The segment likely to do the best between 1987 and 1990 will be the 400-1000 line systems. In the last couple of years centrex growth has been especially strong in the systems above 1000 lines and the smallest systems between 1 and 99 lines. Telephone companies have targetted the largest business for centrex conversion and in addition, for the most part, have encouraged centrex sales by the authorized third-party sales agents to smaller customers.

For individual RBOCs, the largest installed base of PBX lines and also centrex lines is in Bell Atlantic's territory where over 4 million PBX lines and over 2 million centrex lines are installed (see Table 39). As a percent of total centrex/PBX installed base, Ameritech has the highest penetration of Centrex lines at 39 percent (see Fig. 14).

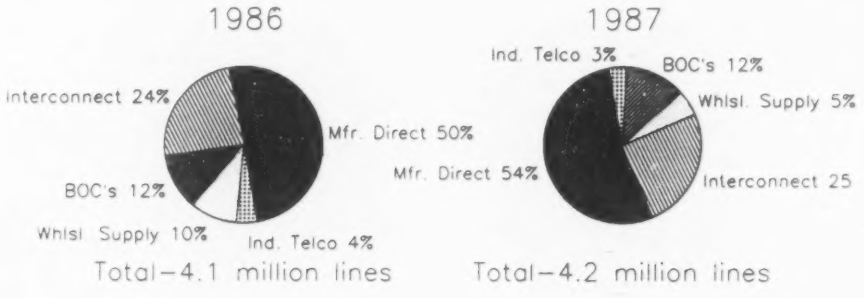
In terms of individual business markets, the business services market has the highest number of PBX lines installed with slightly more than 4 million in 1987, while the manufacturing sector has the highest number of centrex lines in place (see Table 40). As a percent of total centrex/PBX installed base, the Government sector has the highest percentage of centrex lines installed (see Figure 15).

Figure 11.--PBX Market, by System Size, 1984-90



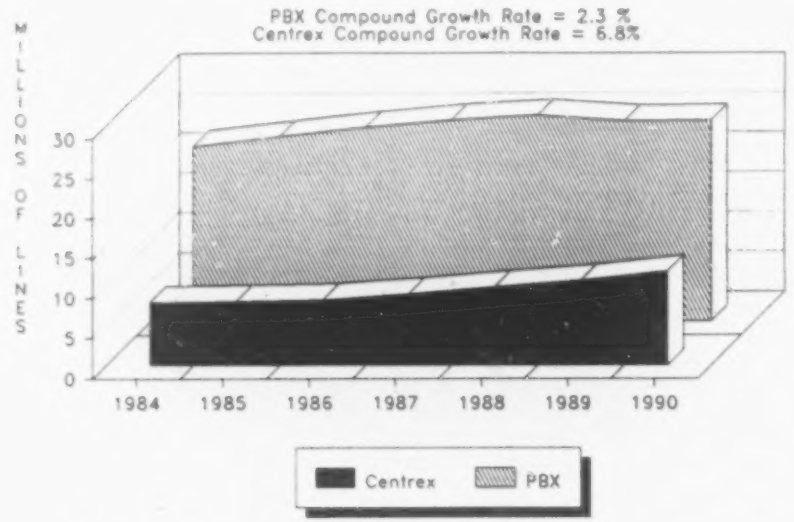
Source: NATA Market Research Department

Figure 12--PBX Shipments by Distribution Channel, 1986 and 1987



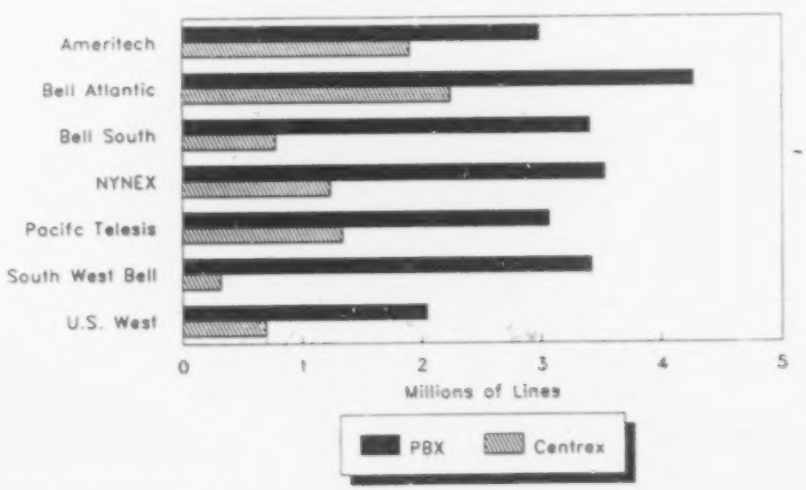
Source: NATA Market Research Department

Figure 13.-- PBX-Centrex Installed Base Development



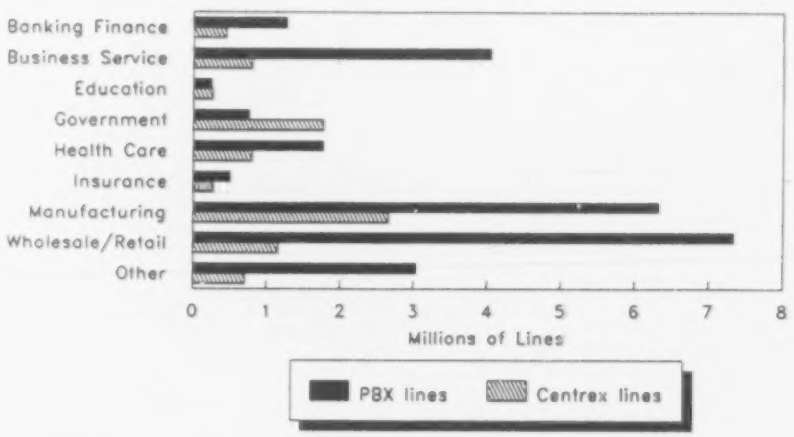
Source: NATA Market Research Department

Figure 14.--PBX-Centrex Lines In Place, by RBOC, 1987



Source: NATA Market Research Department

Figure 15. PBX–Centrex Comparative Market Penetration by End–Use Industry, 1987



Source: NATA Market Research Department

Table 36
PBX Market, 1984-90

	1984	1985	1986	1987	1988(e)	1989(e)	1990(e)	*CAGR 1984-87	*CAGR 1988-90
1-99 Lines per System									
Lines: thousands	948	1,069	1,076	1,086	1,105	1,137	1,184	4.63%	3.51%
Systems: thousands	16.3	18.4	18.5	18.7	19.0	19.5	20.3	4.68%	3.36%
Average Lines per System	58.1	58.1	58.2	58.2	58.2	58.3	58.3		
100-399 Lines per System:									
Lines: thousands	1,061	1,157	1,118	1,127	1,190	1,215	1,225	2.03%	1.46%
Systems: thousands	6.8	7.4	7.1	7.2	7.6	7.7	7.8	1.92%	1.31%
Average Lines per System	157.0	157.0	157.0	157.0	157.1	157.1	157.1		
400-1000 Lines per System:									
Lines: thousands	834	907	911	919	978	1,006	1,031	3.28%	2.67%
Systems: thousands	1.3	1.4	1.4	1.4	1.5	1.6	1.6	2.50%	3.28%
Average Lines per System	644.5	644.5	644.5	644.5	644.4	644.4	644.4		
1000+ Lines per System:									
Lines: thousands	947	982	1,035	1,043	977	1,017	1,050	3.27%	3.67%
Systems: thousands	0.3	0.3	0.3	0.4	0.3	0.3	0.5	10.05%	29.10%
Average Lines per System	2,975.3	2,975.2	2,975.2	2,975.1	2,975.0	2,975.0	2,975.0		
Total:									
Lines: thousands	3,790	4,115	4,140	4,175	4,250	4,375	4,490	3.27%	2.78%
Systems: thousands	24.7	27.5	27.3	27.7	28.4	29.1	30.1	3.89%	2.95%
Average Lines per System	153.4	149.6	151.6	150.7	149.6	150.3	149.2		
Value: millions	$2,843	$3,086	$3,105	$3,050	$3,000	$3,100	$3,150	2.37%	2.47%

(e) Estimated
* Compound Annual Growth Rate

Source: NATA Market Research Department

Table 37
PBX Shipments by Manufacturers' Distribution Channel

	1986		1987	
	Lines (thousands)	Share (percent)	Lines (thousands)	Share (percent)
Manufacturer Direct*	2,087	50.4	2,242	53.7
Interconnect Vendor	998	24.1	1,044	25.0
Wholesale Supply Houses	404	9.7	225	5.4
Bell Operating Companies	479	11.6	518	12.4
Independent Operating Companies	172	4.2	146	3.5

* Includes wholly-owned distributor networks.

Source: NATA Market Research Department

Table 38
PBX-Centrex Installed Base Development

	1984	1985	1986	1987	1988(e)	1989(e)	1990(e)	*CAGR 1984-87	*CAGR 1988-90
	Thousands of Lines								
1-99 Lines per System:									
PBX	5,484	5,794	5,851	6,077	6,085	5,985	5,860	3.48%	-1.87%
Centrex	1,020	1,032	1,126	1,227	1,454	1,694	1,862	6.35%	13.16%
100-399 Lines per System:									
PBX	6,142	6,489	6,826	7,343	7,510	7,292	7,308	6.13%	-1.35%
Centrex	942	953	981	1,062	1,163	1,271	1,385	4.07%	9.13%
400-1000 Lines per System:									
PBX	4,825	5,099	5,607	5,824	5,956	6,035	6,048	6.47%	0.77%
Centrex	1,961	1,986	1,817	1,718	1,855	1,789	1,801	-4.31%	-1.47%
1000+ Lines per System:									
PBX	5,483	5,794	6,095	6,076	6,346	5,833	5,984	3.48%	-2.89%
Centrex	3,923	3,971	4,251	4,846	5,223	5,836	6,595	7.29%	12.37%
Total:									
PBX	21,934	23,176	24,379	25,320	25,897	25,145	25,200	4.90%	-1.35%
Centrex	7,846	7,942	8,175	8,853	9,695	10,590	11,643	4.10%	9.59%

(e) Estimated
* Compound Annual Growth Rate

Source: NATA Market Research Department

Table 39
PBX-Centrex Lines in Place, 1987
(Thousands of Lines)

	PBX	Centrex
Ameritech	2,986	1,903
Bell Atlantic	4,269	2,242
BellSouth	3,406	774
NYNEX	3,530	1,233
PacTel	3,067	1,334
Southwestern Bell	3,420	319
U.S. West	2,045	692
Total	22,723	8,497

Source: NATA Market Research Department

Table 40
PBX-Centrex Penetration
by Industry, 1987
(Thousands of Lines)

	PBX	Centrex
Banking/Finance	1,266	443
Business Services	4,051	797
Education	253	266
State/Local/Federal Government	760	1,771
Health Care	1,772	797
Insurance	506	266
Manufacturing	6,330	2,656
Wholesale/Retail	7,343	1,151
Other	3,039	706
Total	25,320	8,853

Source: NATA Market Research Department

KEY/HYBRID TELEPHONE SYSTEM MARKET

Introduction

Key telephone systems are multi-line business communications systems providing users with shared access to a group of external telephone lines through buttons (or keys) located on the telephone set. Typically, each key is associated with a specific outside line, and that line's number appears on the key. When a user presses a key and lifts the telephone receiver off-hook, a circuit is completed and the user receives a dial tone from the telephone company's central office (CO). The buttons on a key telephone generally light up and flash to indicate the status of the line to which the phone is connected. For example, an unlit button indicates an idle line; a slow flash indicates an incoming call; a fast flash indicates a call on hold; and a steady light indicates that the line is in use. This type of network access is referred to as direct line termination, as each incoming line is connected directly to a specific key on the telephone set.

Key systems are primarily voice communications systems for use in small to medium-sized offices--those requiring from 2 to 120 station sets. These systems provide intraoffice communications links (intercom), shared access to the public switched telephone network and long-distance networks, and limited office-automation functions (such as call accounting).

Key systems can serve either as stand-alones or as adjuncts to larger PBX systems or centrex offerings. As a stand-alone, the key/hybrid, acting as the primary telecommunications systems within a small business or branch office, is connected directly to the local telephone company central office. As an adjunct, the key system is installed alongside a PBX or centrex system, providing users with enhanced access to those switching systems' features, as well as affording greater ease of use than do standard single-line telephone sets. About 30 percent of the installed base of key/hybrid systems in use are used in conjunction with either a PBX or with centrex.

Key systems have evolved from electromechanical types to electronic systems using solid state, integrated circuits and microprocessors. Hybrid key systems are the most recent variety having been introduced in the late 1970s. The designation "hybrid" refers to the key systems ability to provide direct-line-terminated, one-button-per-line network access typical of traditional key systems, or the "dial 9" pooled access characteristic of PBX systems--with some able to provide both types of network access simultaneously to different station sets.

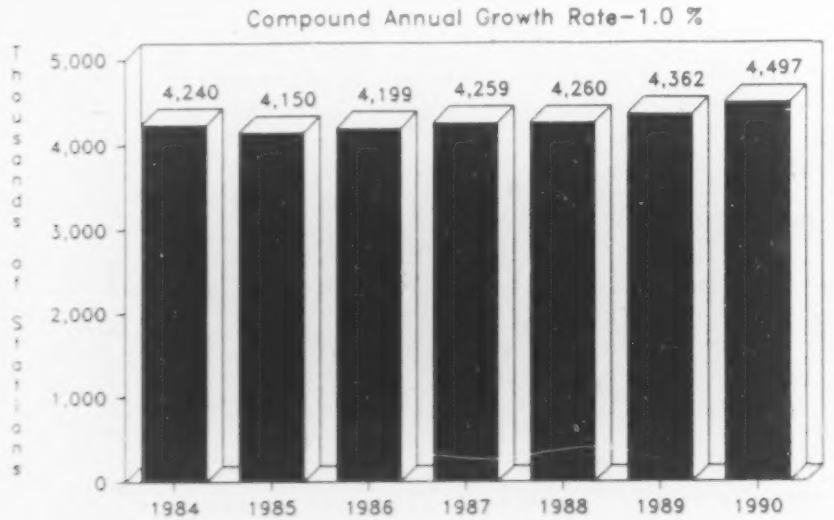
Market Review

The key system market decreased from just over 4.2 million stations valued at over $1.0 billion in 1984 to just under 4.2 million stations valued at $955 million in 1985 (see Table 41). Since then the market has increased very slowly, reaching 4.3 million stations in 1987 valued at $960 million (see Fig. 16). It is anticipated that the growth of the market will accelerate somewhat in the next couple of years and amount to 4.5 million stations valued at $1.0 billion. The market is currently characterized by a relatively large number of suppliers competing for market share. Profit margins have been slim. Vendors of key systems are beginning to market the products creatively. One aspect of that, has been the growth in key systems used in conjunction with Centrex, especially with smaller users. Growth of the market of the smallest line size segment--1 to 24 stations--is expected to grow the fastest between now and 1990 (see Fig. 17).

As with PBXs, manufacturers of key systems are increasingly selling directly to end users. A key development in this, has been the acquisition by manufacturers of interconnect companies. TIE alone, has acquired some 30 interconnect companies in the last several years. As shown in Table 42, manufacturers' direct sales (including wholly owned distribution networks), increased from 1.3 million stations in 1986 (31.1 percent of the market) to 1.4 million stations in 1987 (33.6 percent of the market) (see Fig. 18). Sales by independent interconnects increased from just under 1.9 million stations (44.7 percent of the market) to just over 1.9 million stations (45.3 percent of the market) during the same time period. The two segments which lost market share during 1986-87 were wholesale supply houses and independent operating companies.

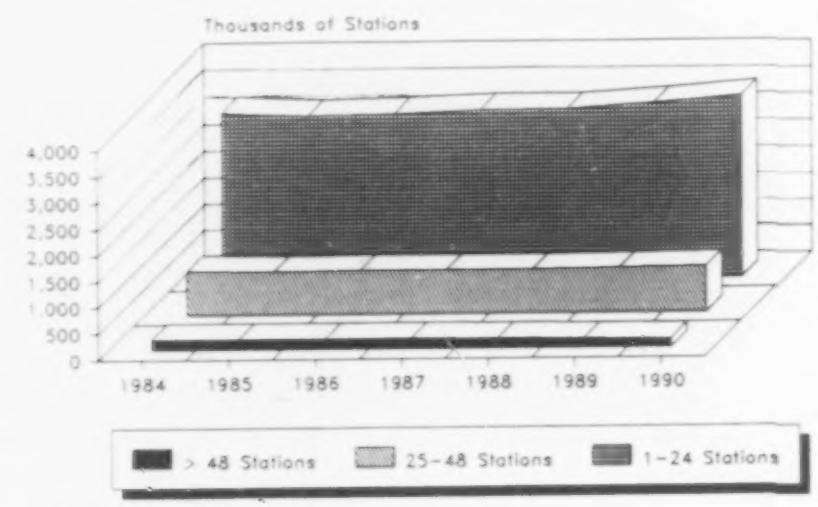
The installed base of key and hybrid key systems in the U.S. increased from 27.6 million stations in 1984 to 29.1 million stations in 1987 and expected to increase to 30.0 million stations by 1990 (see Table 43 and Fig. 19). In terms of systems, the installed base increased from 5.1 million in 1984 to 5.2 million in 1987 and is expected to amount to 5.4 million in 1990.

Figure 16.-- Total Key Station Shipments, 1984-90



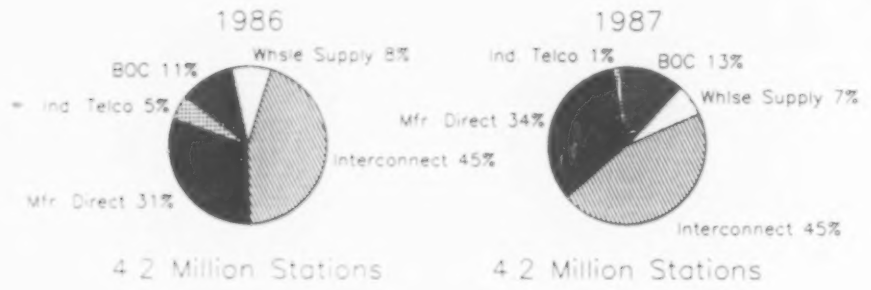
Source: NATA Market Research Department

Figure 17.--Key Telephone Station Shipments by Type, 1984-90



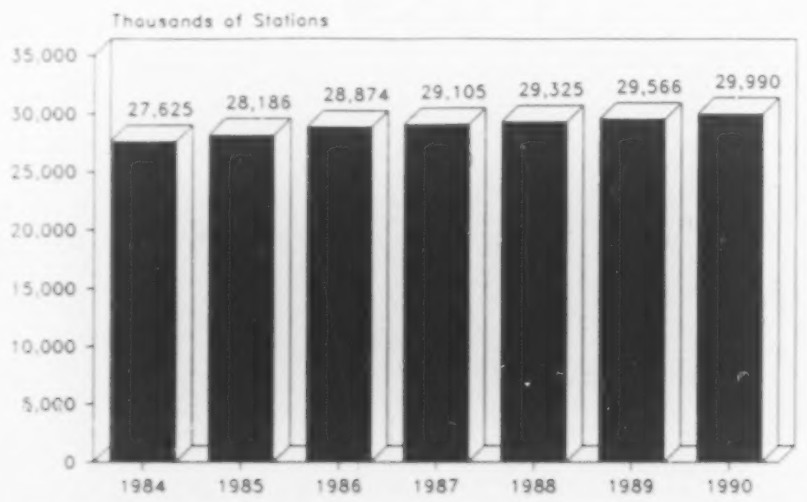
Source: NATA Market Research Department

Figure 18.--Key Shipments by Distribution Channel, 1986 and 1987



Source: NATA Market Research Department

Figure 19.-- Key System Installed Base, 1984-90



Source: NATA Market Research Department

Table 41
Key Telephone Systems Market, 1984-1990

	1984	1985	1986	1987	1988(e)	1989(e)	1990(e)	*CAGR 1984-87	*CAGR 1988-90
1-24 Stations per System:									
Stations: thousands	3,180	3,113	3,149	3,209	3,214	3,313	3,440	0.30%	3.46%
Systems: thousands	432.9	423.7	433.9	436.6	440.4	450.5	462.3	0.28%	2.46%
Avg. Stations per System	7.3	7.3	7.3	7.3	7.3	7.4	7.4	0.00%	0.68%
25-48 Stations per System:									
Stations: thousands	848	830	840	845	846	860	882	-0.12%	2.11%
Systems: thousands	28.8	28.2	28.5	28.6	28.6	29.1	29.7	-0.23%	1.90%
Avg. Stations per System	29.4	29.4	29.5	29.5	29.6	29.6	29.7	0.11%	0.17%
49+ Stations per System:									
Stations: thousands	212	207	210	205	200	189	175	-1.11%	-6.46%
Systems: thousands	4.2	4.1	4.2	4.1	4.0	3.8	3.5	-0.80%	-6.46%
Avg. Stations per System	50.2	50.2	50.2	50.2	50.1	50.1	50.1	0.00%	0.00%
Total:									
Stations: thousands	4,240	4,150	4,199	4,259	4,260	4,362	4,497	0.15%	2.74%
Systems: thousands	465.9	456.0	466.6	469.3	473.0	483.4	495.5	0.24%	2.35%
Avg. Stations per System	9.1	9.1	9.0	9.1	9.0	9.0	9.1	0.00%	0.55%
Value: millions	$1,039	$955	$957	$960	$965	$980	$1,000	-2.60%	1.80%

(e) Estimated
* Compound Annual Growth Rate

Source: NATA Market Research Department

Table 42
Key & Hybrid Shipments by Manufacturers' Distribution Channel

	1986		1987	
	Stations (thousands)	Share (percent)	Stations (thousands)	Share (percent)
Manufacturer Direct	1,307	31.1	1,419.0	33.6
Interconnect Vendor	1,877	44.7	1,913.0	45.3
Wholesale Supply Houses	343	8.2	275.0	6.5
Bell Operating Companies	466	11.1	562.0	13.3
Independent Operating Companies	206	4.9	54.7	1.3
Total	4,199	100.0	4,223.7	100.0

Source: NATA Market Research Department

Table 43
Installed Base of Key and Hybrid Market, 1984-1990

	1984	1985	1986	1987	1988(e)	1989(e)	1990(e)	*CAGR 1984-87	*CAGR 1988-90
Total Stations: thousands	27,625	28,186	28,874	29,105	29,325	29,566	29,990	1.75%	1.13%
Total Systems: thousands	5,085	5,151	5,259	5,197	5,237	5,280	5,355	0.73%	1.12%
Average Stations/Systems	5.4	5.5	5.5	5.6	5.6	5.6	5.6	1.22%	0.00%

(e) Estimated
* Compound Annual Growth Rate

Source: NATA Market Research Department

DATA COMMUNICATIONS EQUIPMENT MARKET

Introduction

Data communications represents the growing overlap area between data processing and traditional communications. As the technologies of the two industries have merged, so have the applications of the technologies. With the proliferation of computers, has come the concept of distributed processing. Traditionally, most computers have been of the mainframe type and the users typically have had access through dumb terminals. If the terminal was not at the same location as the mainframe, a modem was necessary for communications through the telecommunications network. As computer technology evolved with more and more memory and processing available from smaller and smaller machines, mini computers and personal computers began to evolve. Now it has reached the point that much of the data processing that is being conducted is done away from the mainframe and the mainframe is used principally to manage extremely large databases or perform very complex data processing tasks.

The tremendous growth in distributed processing and computers in general has caused the data communications market to grow rapidly. In addition, there is a large and growing market for value added networks (VAN) such as credit card validation, electronic funds transfer, electronic mail, etc. that are having a significant impact on the demand for data communications equipment. Of the numerous types of data communications equipment, those addressed here include modems, multiplexors, packet switching equipment, front-end processors, concentrators, and network controllers.

Modems, which were developed in the early 1950s, are one of the oldest types of data communications products. The word "modem" is a contraction for modulator/demodulator. Modems are used to interface a computer with the telephone network. The modem converts the computer's binary code into a form that can be transmitted by telephone line using audio-frequency shift keying tones. At the other end a second modem converts the signal back to binary. Modems can be made to operate at different speeds, depending upon the system architecture at both ends.

Multiplexors are devices which cause the interweaving of several communications signals or channels to increase the capacity of a telecommunications network. This interweaving can either be done by frequency division, in which, each channel is allocated a different frequency within the wideband carrier; or by time division, in which each channel consists of a series of pulses, interleaved on a time-sharing basis. One of the more increasingly popular types of multiplexor is the T1 multiplexor. This device multiplexes channels through a T1 circuit. A T1 circuit is a high capacity, time-multiplexed transmission system. It is being used increasingly to interconnect telephone company central offices, provide private voice and data networks, video transmission, long distance communications, etc.--basically any situation where high capacity and speed are necessary. Another advantage of T1 networks is the compatibility with digital PBXs, packet switching nodes, and asynchronous terminals.

Packet switches are devices which also increase the capacity of telecommunications networks by enabling a single channel to be used for multiple concurrent transmissions. This can be accomplished because the data to be transmitted to different destinations are formed into packets to which electronic addresses are assigned. The data are then sent as a continuous stream and switched to appropriate destinations by means of a packet switch. Packet switches are efficient for "bursty" high- speed data communications because lines are tied up only while data are transmitted. In contrast, circuit switching maintains an open connection even when no information is being transmitted. Data transmission over a packet-switched network can be at least 50 percent cheaper than over normal circuit-switched telephone lines. Packet switching networks are becoming very popular due to their use in VANs.

Front-end processors are auxiliary computers which are attached to a network to perform control operations, thus freeing up the host computer for data processing. Increasingly, software is being developed for the front-end processor that allow for support of multiple host-computers, network diagnostics and protocol conversion.

Concentrators are devices that perform a function similar to both multiplexors and packet switches in the sense that both types of equipment are designed to maximize the capacity of a given telecommunications transmission circuit. Concentrators can be of several different types. One popular type is a compression concentrator. This device compresses

the data by reducing the number of bits required to represent a character, or a whole block of data, so that the user gains more transmission bandwidth.

In the context of this report, network controllers are the devices at the heart of a local area network (LAN). Depending on the manufacturer, network controllers can be configured differently. They all, however, have certain features in common. They provide a physical interface to the transmission medium, monitor the busy/idle status of the network, convert terminal protocol to the network protocol, assemble the transmitted data stream into packets for transmission and reconverts it at the point of reception, and generally manages the speed and logistics of the network.

Market Review

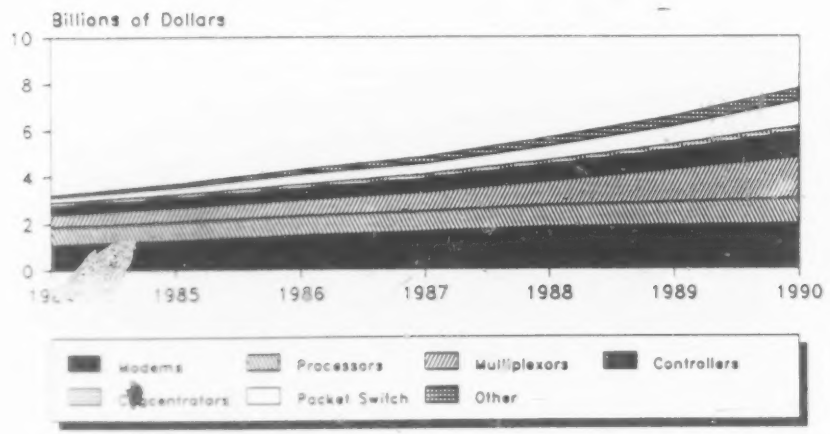
The data communications market has increased rapidly over the last several years from $3.2 billion in 1984 to $4.8 billion in 1987, and is expected to reach $7.8 billion by 1990 (see Table 44). Part of the increase in sales of data communications equipment can be attributed to increasing sales by interconnect companies. In an effort to increase profitability and customer satisfaction, interconnects have begun to broaden the scope of the their product and service offerings.

The market for modems grew at a rather healthy rate during 1984-87, but is expected to level off somewhat in the future, as all digital networks are put in place which obviate the need for a modem (see Fig. 20). It will be many years however, before the entire telecommunications network is digital and in the meantime, the proliferation of personal computers, especially in the home, will keep the demand for modems at a moderate level.

Products that maximize the capacity of a network, like multiplexors, packet switching equipment, and concentrators have recently become important as users begin to demand high speed data lines for the explosion of new data networks that has occurred. Network managers need to ensure that the capacity exists in the network to allow for continued growth of these networks. The market for multiplexors has grown steadily from 550 million in 1984 to $840 million in 1987. Growth is expected to accelerate in the next several years to reach $1.8 billion by 1990. This dramatic rise will result from increased use of T1 networks for data and voice transmission and ultimately for ISDN. Largely as a result of VANs, the market for packet switching equipment has increased from $225 million in 1984 to $452 million in 1987 and is expected to exceed $1.0 billion in 1990. The market for concentrators has increased from $165 million in 1984 to $209 million in 1987 and is expected to increase to $250 million by 1990.

As communications to and between mainframe computers becomes commonplace, front-end processors will be required more and more to sort out the protocols and other aspects of the communications. The market for these devices has increased moderately from $751 million in 1984 to $845 million in 1987, but is expected to increase more rapidly in the future and amount to over $1.0 billion by 1990. Likewise, as the need for communications between personal computers becomes stronger, and LANs become more popular, especially for intraoffice communications, the market for network controllers will grow. The market for this equipment increased from $332 million in 1984 to $560 million in 1987 and is expected to grow to $1.1 billion by 1990.

Figure 20.--Data Communications Equipment Market, by Type of Equipment, 1984-90



Source: NATA Market Research Department

Table 44
Data Communications Equipment Market, 1984-90

	1984	1985	1986	1987	1988(e)	1989(e)	1990(e)	*CAGR 1984-87	*CAGR 1988-90
	Millions of Dollars								
Modems	1,100	1,266	1,500	1,650	1,848	1,910	1,950	14.46%	2.72%
Multiplexors	550	613	700	840	1,050	1,400	1,800	15.14%	30.93%
Packet Switching	225	305	410	452	601	800	1,075	26.15%	33.74%
Front-end Communications Processors	751	790	815	845	896	960	1,055	4.01%	8.51%
Concentrators	165	180	197	209	219	230	250	8.19%	6.84%
Network Controllers	332	390	470	560	683	855	1,085	19.02%	26.04%
Other	100	150	210	290	360	430	550	42.55%	23.60%
Total	3,223	3,694	4,302	4,846	5,657	6,585	7,765	14.55%	17.16%

(e) Estimated
* Compound Annual Growth Rate

Source: NATA Market Research Department

FACSIMILE TERMINAL MARKET

Introduction

A facsimile terminal is a devices that scans a document, encodes the information on the document, and transmits the document over a telecommunications circuit to be reproduced at the receiving end. The scanner sweeps across a page of the document, segmenting it into multiple lines in an analagous fashion to the way an electron beam scans the faceplate of a television picture tube. The scanner produces an output that is either a continuous analog signal that varies between black and white, or it is a digital output that converts the image to a binary code. Control equipment directs the scanning rate, and in the case of digital facsimile, it processes the signal to compress solid expanses of black or white. At the receiving end, the incoming signal is demodulated and drives a print mechanism that reproduces the received image on paper.

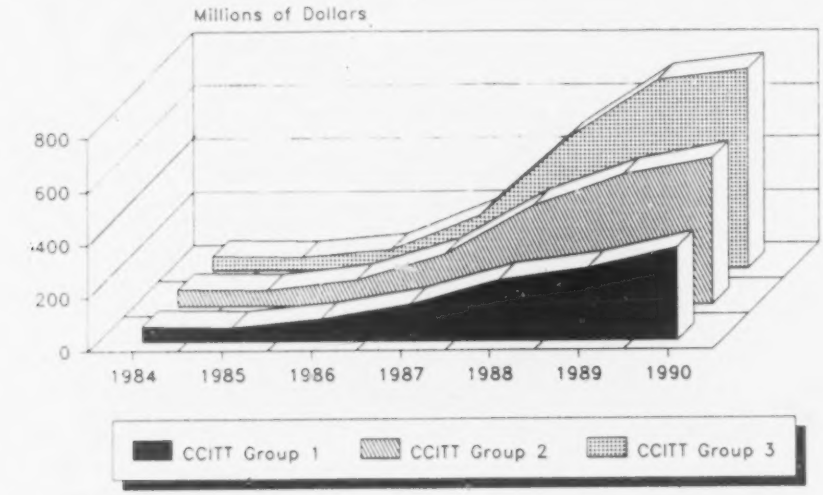
Facsimile transmission was invented in 1843. Despite this early introduction, facsimile transmission was not used very extensively until the 1920s when it began to be used for transmitting wire photographs and weather maps. It has only recently become a business tool. Early models were bulky and produced rather poor quality copy. Recent innovations have made the facsimile terminal practical for a mass market.

Since facsimile transmission involves the coding of information, there must be standardization of the coding format to achieve universal intercommunication. The most prevalent standards currently in use have been established by the CCITT, a committee within the International Telecommunications Union, part of the United Nations. The CCITT has established three standards for facsimile transmission; another is under development. The three standards are referred to as Group 1, Group 2, and Group 3; the one under development is called Group 4. Group 1 requires six minutes for transmission of a printed page, Group 2 requires two to three minutes; and Group 3 requires one minute or less. Group 4 will be even faster.

Market Review

The market for facsimile terminals has taken a number of years to reach the critical mass necessary for the market to explode. In terms of the value of the market, there was even a slight slump in 1985, when the market amounted to $164 million, down from $175 million in 1984 (see Table 45). Since 1985, however, the market has experienced tremendous growth. In 1987, the market amounted to 150 thousand terminals, valued at $539 million. The market is expected to soar even more rapidly in the immediate future and reach 825 thousand terminals in 1990 valued at $1.7 billion. The growth of the relative market shares of the different CCITT group types are revealed in Figure 21.

Figure 21.--Facsimile Terminal Market, by Type, 1984-90



Source: NATA Market Research Department

Table 45
Facsimile Terminal Market, 1984-90

	1984	1985	1986	1987	1988(e)	1989(e)	1990(e)	*CAGR 1984-87	*CAGR 1988-90
Quantity: thousands	35	36	75	150	375	590	825	62.35%	48.32%
Value:									
CCITT Group 1: $ millions	58	54	86	141	231	275	350	34.42%	23.09%
CCITT Group 2: $ millions	63	60	96	194	374	490	550	45.43%	21.27%
CCITT Group 3: $ millions	54	50	78	204	495	710	750	55.68%	23.09%
Total Value: $ millions	175	164	260	539	1,100	1,475	1,650	45.44%	22.47%

Note: CCITT Group numbers refer to international transmission standards.

(e) Estimated
* Compound Annual Growth Rate

Source: NATA Market Research Department

CELLULAR TELECOMMUNICATIONS MARKET

Introduction

Cellular telecommunications systems are the newest generation of radiotelephone systems. Radiotelephones have been around for many years but were limited in market penetration due to the scarcity of radio frequency available. Cellular telecommunications solves that problem by dividing a geographic area into cells and reusing the frequencies in nonadjacent cells (see Fig. 22). Each cell has a low power transmitter which can only transmit within a limited area. When a person with a cellular phone travels from one cell to another, the call is "handed off" to the transmitter of the second cell. These two aspects of frequency reuse and handing off allow for a great many more subscribers than traditional mobile telephone systems.

While cellular technology has been around for a number of years, the commercial implementation of the technology had to receive approval by the Federal Communications Commission (FCC). Introduction of cellular service on a commercial scale occurred in 1984. The FCC mandated that there be two systems operators per market area, one of which was designated to be the local telephone company. The awarding of the licences for the other systems became very chaotic as the revenue potential became known and the FCC was flooded with applications. At the end of 1987 there were 215 systems on-line in 160 cities.

In general, the cellular industry can be divided into four clearly defined segments: (1) Manufacturers of cellular telephones; (2) Manufacturers of radio frequency apparatus for the cell sites; (3) Manufacturers of switching apparatus for the mobile telephone switching office; and (4) Operators of cellular systems. In addition, other miscellaneous segments have developed that feed off one or more of the four main sectors. One example is the cellular telephone reseller. This type of company markets to potential cellular subscribers and receives a commission from the system operator for every subscriber he/she signs up.

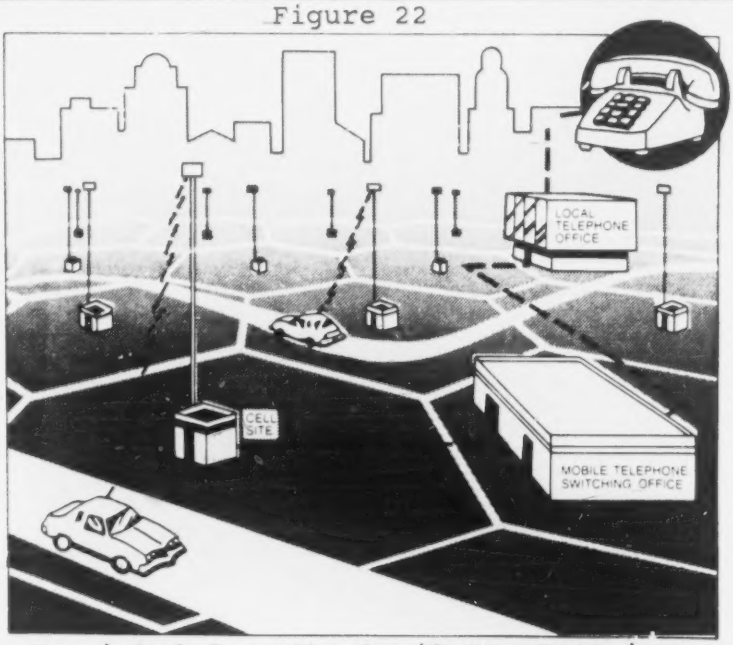
Market Review

The total number of cellular subscribers in the United States has increased from 91.6 thousand in 1984 to 1.1 million in 1987 and is expected to increase to 2.5 million by 1990 (see Table 46). Cellular telephones, originally marketed principally to businesspeople, are becoming a consumer product. The prices of the phones themselves have decreased from $2,000-$4,000 per phone three to four years ago to $500-$1,000 today for a basic phone. Recent inroads made by producers in Hong Kong, Singapore, and South Korea indicate that the price of the phones is likely to fall further.

The other impediment to the mass market is the monthly price of the service. That too is dropping, although not quite as rapidly. The service is generally still more than regular telephone service, but as the number of subscribers increase, the cheaper it will become, as the marginal cost per subscriber decreases. The annual capital investment costs have increased from $234 million in 1984 to $526 million in 1987 (see Fig. 23). Service revenues have increased from $178 million in 1984 to $960 million in 1987.

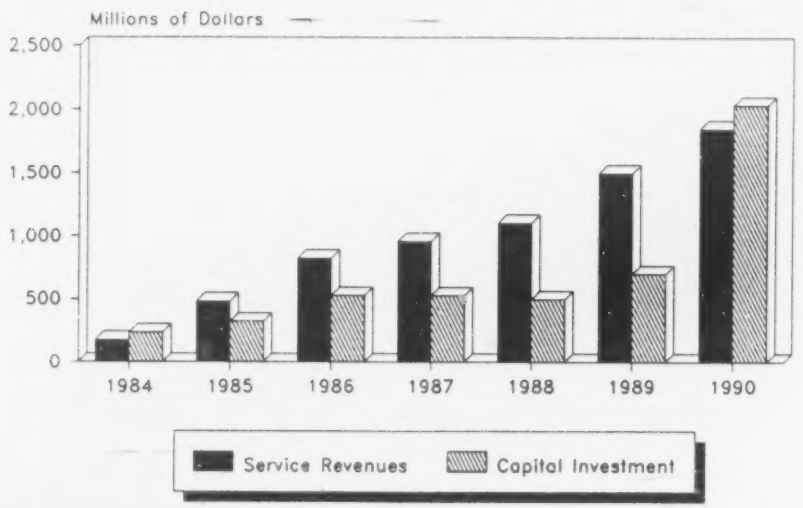
Beginning around 1990, the cellular telecommunications network will begin to convert to digital technology. While the current analog systems have tremendous capacity compared to what was available before, there are practical limitations to the number of subscribers per system. For a given amount of radio frequency, digital technology will allow the systems to have significantly more subscribers than analog systems. In addition, there are technical reasons which make digital technology superior to analog. Once the digital systems are in place, the marginal cost per subscriber will likely decrease dramatically. At that point, it is projected that cellular will become a relatively inexpensive consumer product/service and according to industry sources may reach penetration levels of 25-50 percent of the population.

Figure 22



Source: Reprinted from the April 13, 1981 issue of Business Week by special permission, copyright by McGraw-Hill, Inc.

Figure 23.--Cellular Service Revenues and Annual Capital Investment, 1984-90



Source: U.S. Department of Commerce

Table 46
Cellular Market, 1984-90

	1984	1985	1986	1987	1988(e)	1989(e)	1990(e)	*CAGR 1984-87	*CAGR 1988-90
Subscribers: number	91,600	340,000	682,000	1,100,000	1,500,000	2,000,000	2,500,000	47.84%	29.10%
Capital Investment:									
Annual Spending: $ millions	234	322	526	526	500	700	2,037	17.75%	101.84%
Comulative Total: $ millions	589	911	1,437	1,963	2,463	3,163	5,200	29.13%	45.30%
Service Revenue: $ millions	178	482	823	960	1,104	1,500	1,850	25.79%	29.45%
Number of Systems	33	105	171	215	230	250	255	26.95%	5.29%

(e) Estimated by the NATA Market Research Department
* Compound Annual Growth Rate

Source: U.S. Department of Commerce

CONSUMER TELECOMMUNICATIONS MARKET

Introduction

The consumer telecommunications market had its roots over a hundred years ago when the telephone was invented. Over the years the telephone and the telephone system evolved to provide users with better service and more features. The telephone itself has evolved from an electromechanical to an electronic device. The switch to electronics began to occur in the 1960s and 1970s as the transister gave way to its successor, the integrated circuit. With the conversion to electronics, advanced features became available. In the late 1970s the cordless telephone and the consumer telephone answering machine began to be developed. On the horizon for consumer telecommunications is the ISDN which will provide consumers with the ability to achieve voice, data, and video communication through a video telephone terminal. Common services most likely to be available will be catalogue browsing and shopping, electronic mail, electronic banking, etc. This study however, addresses only the U.S. market for corded telephones, cordless telephones and telephone answering machines.

Over 90 percent of the households in the United States have telephone service. That represents a large market for telephone instruments. Since the late 1960s, consumers have been practically able to buy and install telephone equipment. However, it has not been until the 1980s that the market began to explode. During 1982-84, cheap, one-piece telephones became extremely popular, and millions of them were sold. Their popularity died out, however, due to lack of good sound quality and reliability. Currently, the market for consumer phones is driven by features.

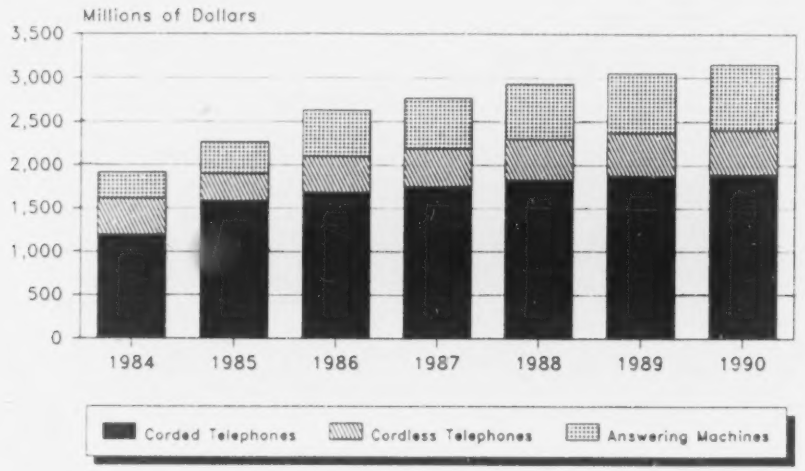
Market Review

The market for all types of telephones increased from $1.2 billion in 1984 to $1.8 billion in 1987 (see Fig. 24). It is expected to increase to $1.9 billion by 1990. The market for full-feature phones has been the fastest growing segment, increasing from $110 million in 1984 to $589 million in 1987. The changes in relative market shares of the different types of phones is presented in Figure 25.

The market for cordless telephones also went through a period of extreme popularity in the early 1980s but began to fizzle as problems with unauthorized use (or monitoring), sound quality, and reliability became apparent. New models, using different frequencies and having increased protection from unauthorized use became available in the mid-1980s. The market for cordless telephones decreased from $410 million in 1984 to $305 million in 1985 before increasing to $438 million in 1987.

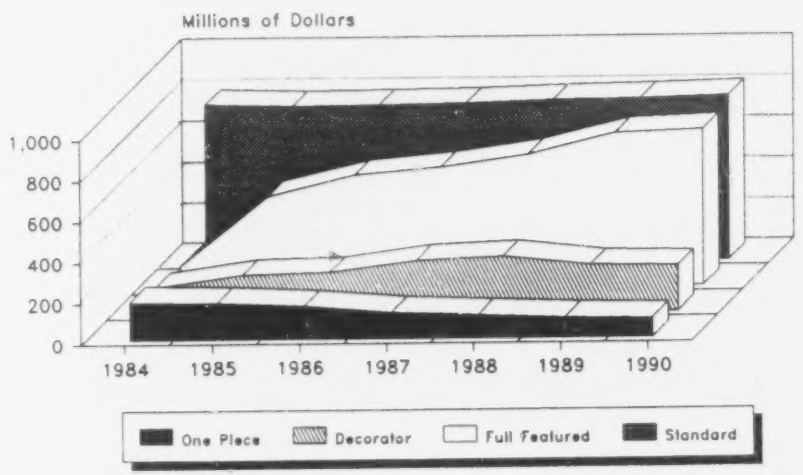
The market for telephone answering machines has increased from $298 million in 1984 to $577 million in 1987. The demand for telephone answering machines has been held in check by reluctance on the part of some consumers to "talk into a machine." This reluctance, however, is becoming overcome as the society becomes dominated by families where both spouses work, and there are large segments of time during the day when no one is home. In addition, more businesses are installing voice messaging systems (discussed in the next section) which is making the general public more comfortable with leaving a message. Also, the BOCs were recently granted the ability to offer voice messaging services. Undoubtedly, before long, there will be BOC advertising campaigns under way across the country which will familiarize people with the benefits of talking into a machine.

Figure 24.--Consumer Telecommunications Equipment Market, 1984-90



Source: Various Industry Sources
(see table 47)

Figure 25.--Corded Telephone Instrument Market, by Type, 1984-90



Source: Various Industry Sources
(see table 47)

Table 47
Consumer Telecommunications Market, 1984-90

	1984	1985	1986	1987	1988(e)	1989(e)	1990(e)	*CAGR 1984-87	*CAGR 1988-90
Corded Telephone Instruments:	- - - - - - - - - - Millions of Dollars - - - - - - - - - -								
Standard	775	765	770	775	788	795	805	0.00%	1.07%
One Piece	185	180	162	129	115	100	95	-11.31%	-9.11%
Decorator	130	190	202	257	275	230	225	25.48%	-9.55%
Full-Featured	110	450	551	589	647	750	765	74.85%	8.74%
Total	1,200	1,585	1,685	1,750	1,825	1,875	1,890	13.39%	1.77%
Cordless Telephones	410	305	410	438	474	498	515	2.22%	4.24%
Telephone Answering Equipment	298	371	535	557	634	680	750	23.16%	8.76%

(e) Estimated
* Compound Annual Growth Rate

Source: Extrapolated by the NATA Market Research Department based on various industry sources.

CALL/VOICE HANDLING EQUIPMENT MARKET

Introduction

The type of equipment discussed in this section answers, records, routes, distributes, makes, or otherwise manipulates telephone calls. The specific products addressed are voice messaging systems, automatic call distributors, and automatic dialers.

Probably the most popular of the three is the voice messaging system, a product that has been around in its present form only since the early 1980s. Voice messaging, also called voice mail, is sometimes available as an optional feature on a PBX, but frequently it is a separate piece of equipment that is used as an adjunct to a business telecommunications system. A caller dials the called party's mailbox number and leaves a messsage. The called party can retrieve messages by dialing the mailbox from any touch-tone telephone and entering a security code. By entering instructions from the dial, the message can be repeated, erased, or filed.

Compared to an ordinary consumer answering machine, voice mail gives the called party more flexibility. Voice messaging systems have become popular, especially with businesses by reducing the need for an operator/receptionist/secretary to answer calls and take messages. Some studies estimate that 50 percent of all telephone calls made are simply to convey information and do not require a two-way conversation. In many cases, the age-old game of "telephone tag" can be cut considerably, if not eliminated.

An automatic call distributor (ACD) is a device that concentrates incoming calls to a group of service positions. An ACD is either a stand alone system or included as a feature in a PBX. Typical applications are the service positions of any large organization that gets many calls such as airlines, utilites, catalog houses, and department stores. Incoming calls can be routed to an attendant position on the basis of incoming line type or other variables. When attendant positions are idle, the call is routed immediately. When the attendant positions are busy, the calls are answered and placed in a queue and the caller is notified by a recorded announcement that the call will be held until the next available operator is free.

Automatic dialers are of two different basic varieties--consumer type and business. The consumer type allows the user to enter in commonly called telephone numbers that can be activated with the touch of one button. The type that is discussed in detail in this report, the business type of automatic dialers, is used almost exclusively by telemarketing firms to increase productivity. These products are similar to "telecomputers" which dial up numbers and give recorded messages or conduct prerecorded interviews.

Automatic dialers, however, connect the called party with a live telephone sales representative. These devices typically have advanced functions such as the ability to get some general information about the account or other information about the called party on a screen before the sale is made. Other advanced features include "intelligent" autodialing or the ability of the device to detect whether the call is answered or not, and if not, hang up. Automatic dialers have been estimated to improve telemarketing productivity up to 50 percent.

Market Review

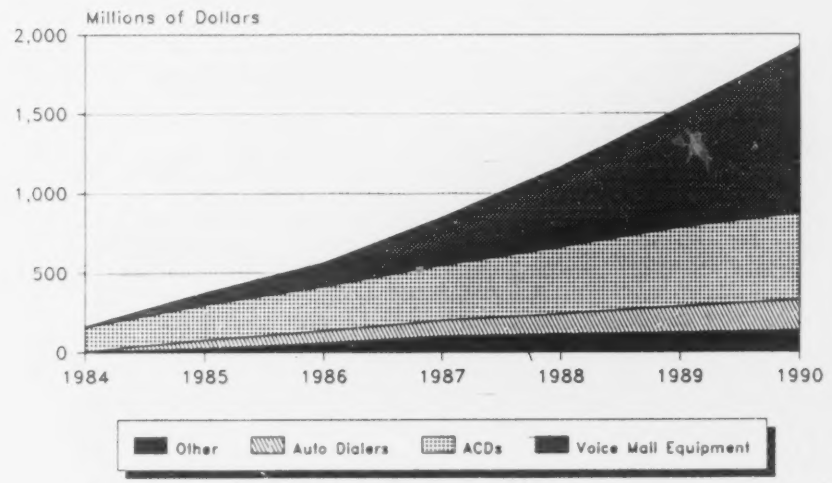
The market for call/voice handling equipment has increased from $163 million in 1984 to $850 million in 1987 (see Table 48). Most of this equipment is distributed and installed by the interconnect industry. These products have been some of the key add-on peripherals that interconnects have begun to sell to increase profit margins and customer satisfaction.

The principal product area is the voice messaging equipment market, which increased from $5 million in 1984 to $300 million in 1987 (see Figure 26). The market for this equipment is expected to increase dramatically to over $1.0 billion by 1990. In addition, the FCC recently decided to allow telephone companies to offer voice messaging services. While many analysts believe that this will stimulate the market, others are concerned that the initiative may lead to a contraction in the industry due to the extensive resources available to the telephone companies and the possibility of anti-competitive activities.

The other types of equipment are more niche-type products. Even still the market for ACDs has increased from $150 million in 1984 to $350 million in 1987 and is expected to amount to $550 million in 1990. The market for automatic dialers increased

from $3 million in 1984 to $100 million in 1987 and is expected to increase to $550 million by 1990.

Figure 26.--Call/Voice Handling Equipment Market, by Type, 1984-90



Source: NATA Market Research Department

Table 48
Call/Voice Handling Equipment, 1984-90

	1984	1985	1986	1987	1988(e)	1989(e)	1990(e)	*CAGR 1984-87	*CAGR 1988-90
	Millions of Dollars								
Voice Messaging Equipment	5	75	150	300	500	750	1050	290.95%	44.91%
Automatic Call Distributors	150	225	280	350	425	500	550	32.60%	13.76%
Automatic Dialers	3	50	75	100	125	160	190	221.45%	23.29%
Other Equipment	5	25	60	100	115	125	135	171.17%	8.35%
Total	163	375	565	850	1,165	1,535	1,925	73.32%	28.54%

(e) Estimated
* Compound Annual Growth Rate

Source: NATA Market Research Department

PUBLIC PAYPHONE MARKET

Introduction

In June 1984, the FCC opened the interstate pay telephone equipment market to competition. The FCC ruled that parties other than telephone companies may own pay telephones connected to the interstate telephone network, provided that the equipment is registered under Part 68 of the Commission's rules and regulations. At the time the FCC made its ruling, there were approximately 1.8 million telco-owned pay stations throughout the United States. The alternative operator services (AOS) industry is an industry which has developed in concert with, and even as a part of the private payphone industry. In short, the AOS industry are those companies that provide the same type of operator service that the local telephones do when a caller dials "0". Some of the operators of private payphones are also AOS providers. While this is a parallel industry to the private payphone industry, the discussion in this report will focus on the payphone market.

While the 1984 FCC ruling opened the way for entrepreneurs to connect telephones to the interstate telephone network, the terms and conditions for connecting the payphones for local and intrastate calling were left to the states. As a result, while the market is growing rapidly, pay phone regulations vary widely across the states.

Privately-owned pay telephones are different from their telco-owned counterparts in that the privately owned units must be able to perform many of the monitoring functions traditionally associated with the central office. Payphones are now capable of offering many advanced features that were not available in 1984. Some of the advanced features include credit card calling, voice synthesizers that provide usage information to the caller, accounting functions, and self diagnostics. Most of these are on the privately-owned payphones, but the telcos are realizing their importance, and are beginning to install the more sophisticated types and even retrofitting many of their older phones to have advanced features.

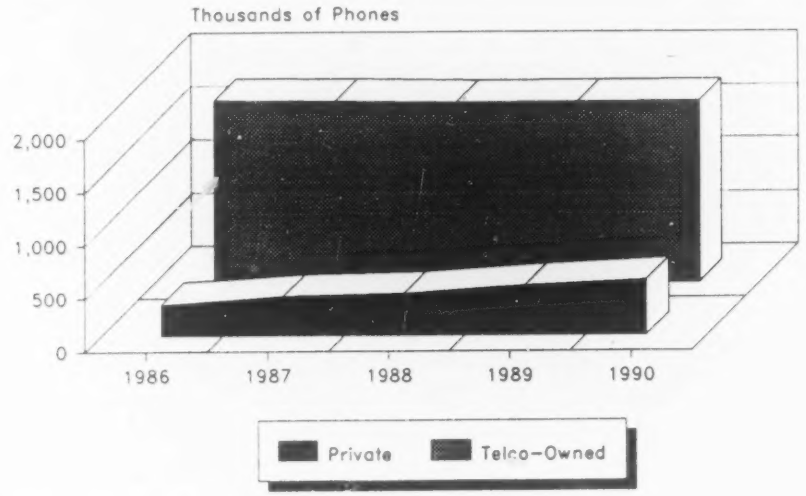
Market Review

The annual market for payphones increased from 27 thousand units valued at $40 million in 1986 to 45 thousand units valued at $60 million in 1987 (see Table 49). It is expected that sales of payphones will continue to grow rapidly and amount to 175 thousand units valued at $185 millionby 1990.

In terms of the installed base, telco-owned payphones decreased slightly from 1.72 million units in 1986 to 1.71 million units in 1987. The trend is expected to continue into 1988, when it is expected that the telco-owned payphone installed base amounts to less than 1.7 million units. It is projected that thereafter the telcos installed base will grow somewhat and amount to 1.7 million in 1990. The installed base of privately-owned payphones increased from 300 thousand units in 1986 to 375 thousand in 1987 and is expected to increase to 525 thousand by 1990. Figure 27 shows the relative shares of the installed base between telco-owned and private payphones for 1987 and projected 1990.

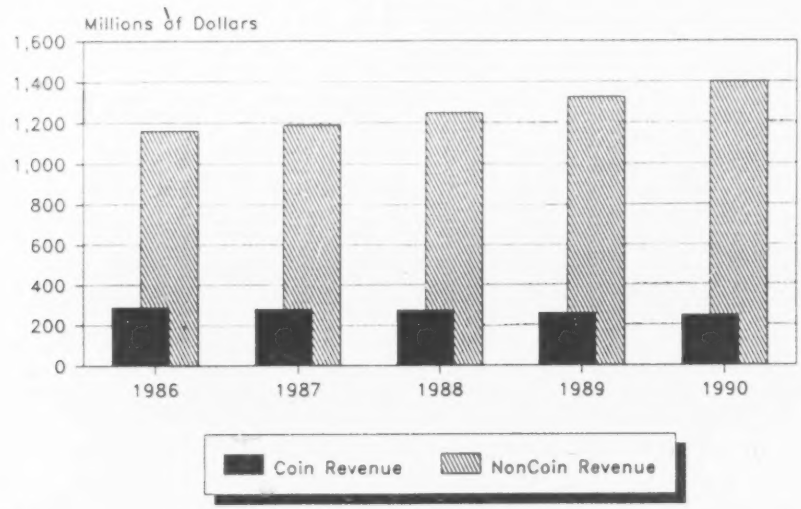
RBOC revenue generated from public payphones decreased from 1.49 billion in 1986 to 1.47 billion in 1987 (see Fig 28). It is expected to increase thereafter to more than $1.6 billion by 1990. As a share of the total, revenue from coin calls decreased during 1986-87, and is expected to continue to decrease through 1990. The non-coin revenue is almost exclusively attributed to toll calls.

Figure 27.-- Public Payphone Installed Base, 1986-90



Source: NATA Market Research Department

Figure 28.--BOC Revenues fom Payphones, 1986-90



Source: NATA Market Research Department

Table 49
Public Payphone Market

	1986	1987	1988(e)	1989(e)	1990(e)	*CAGR
Annual Sales:						
Quantity: thousands	27	45	90	140	175	59.56%
Value: $ millions	40	60	100	150	185	46.65%
Installed Base:						
Telco-owned: thousands	1,715	1,708	1,690	1,695	1,700	-0.22%
Non Telco-owned: thousands	300	375	400	475	525	15.02%
BOC Publi: Payphone Revenue:						
From Coin Calls: $ millions	290	279	275	260	250	-3.64%
Other: $ millions	1,162	1,191	1,250	1,325	1,400	4.77%

(e) Estimated
* Compound Annual Growth Rate

Source: NATA Market Research Department

INTENTIONAL
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APPENDIX A
PUBLIC POLICY OVERVIEW

Telecommunications public policy during the past two years has been one of continual battles between the Administration, pushing for additional deregulation, and an increasingly skeptical Congress. The central theme of the fight has been the persistent effort to re-establish the old Bell monopoly, this time on a regional level. At every turn, the Regional Bell Holding Companies (RHCs) and their allies have attacked the Modified Final Judgment (MFJ), the court decree which broke up AT&T.

In the Federal Court, in the Congress, and at the Federal Communications Commission (FCC), the Bell Companies have been persistent in their efforts to whittle away at the line-of-business restrictions placed on them by the MFJ.

As the period covered by this overview began, Judge Harold Greene of the United States District Court for the District of Columbia completed his first triennial review of the MFJ, loosening some of the restrictions on the RHCs and retaining others. As the period came to an end, the RHCs had renewed their efforts to pressure the Congress into legislating an end to the restrictions, thus allowing them to manufacture and to become fully involved in all aspects of providing information services.

Also highlighting the period was final approval of a massive trade bill designed, according to proponents, to enhance America's trade position worldwide.

THE FEDERAL COURT

All branches of the federal government have been active on various MFJ-related matters in the past two years, but certainly none has been busier than the U.S. District Court. The court completed the first triennial review of the MFJ and, in a series of rulings, allowed the RHCs into certain additional lines of business.

On February 2, 1987, the U.S. Department of Justice issued its report and recommendations to the Court on changes it felt were necessary in the MFJ. In keeping with Administration policy, the Department recommended removal of most of the line-of-business restrictions on the RHCs. It said that the RHCs should be allowed to manufacture, to fully provide information services, and to go into any non-telecommunications business. It also recommended that they be allowed to provide interexchange services outside of their specific region.

In a series of filings with the Court, NATA opposed the Department's recommendations in the strongest of terms. Arguing that "The RBOCs retain both the ability and incentive to use their control of local exchange monopolies to impede competition," NATA said that "there is no existing or prospective regulatory regime capable of preventing severe anticompetitive effects." NATA went on to conclude that the removal of the restrictions would be "ill-grounded and premature."

On September 10, 1987, the court ruled that it would continue the prohibition on RHC manufacturing and the provision of inter-LATA long distance service. NATA was both pleased with the decision and gratified to note that the Judge used its arguments in his decision almost verbatim. At the same time, it allowed the RHCs limited entry into the provision of information services, and unlimited entry into non-telecommunications businesses. It Left unresolved by this decision was the question of what exactly constituted "manufacturing" (for example, was research and development covered?) and the extent to which the Bells could be involved in information services.

In two subsequent rulings, the Court clarified those matters. On December 3, 1987, Judge Greene ruled that product design and development were indeed part of manufacturing and, as such, were activities prohibited by the MFJ. Then, in March 1988,

This review covers the period from January 1987 through September 1988.

after a further series of hearings, the judge ruled that the RHCs could provide gateway transmission for information services, but that they could not own the actual databases.

A number of the RHCs responded with various pleas for clarification or reconsideration of the information services ruling. They were particularly anxious to provide electronic yellow pages services. In July 1988, the Court rejected these pleas and took a real slap at the RHCs. The Judge wrote, "Judicial rulings in favor of the positions advocated by regional companies have in the past often been followed, not by statements of resolve to take advantage of new opportunities or by the adoption of imaginative new programs, but by public expressions of disappointment, nay, amazement that the decree restrictions were not further or completely removed."

THE CONGRESS

This period on Capitol Hill has seen a great deal of posturing, a great deal of talk, constant battles between the Administration and Telecommunications Subcommittees, and very little legislative action on telecom issues. The one exception has been the passage of a massive trade bill, containing a section dealing specifically with telecommunications trade issues.

The so-called Tauke-Swift bill, H.R. 2030, was reintroduced into Congress in 1987. The measure, a modified version of the earlier Swift-Tauke bill, would allow the Bell companies to manufacture and to provide information services. Interestingly, it would specifically prohibit the RHCs from getting into electronic publishing, a testament to the political clout of the nation's newspaper publishers with elected officials. The bill is silent on the question of letting the RHCs into long distance service, thus permitting the MFJ restriction to stand.

The measure was greeted in the Congress with something less than overwhelming enthusiasm. Its introduction came at a time when the triennial review of the MFJ was underway. Many legislators, understandably leery of opening up such a controversial can of worms so soon after the initial approval of the MFJ, were determined to take a wait-and-see approach. Cong. Ed Markey, Chairman of the House Subcommittee on Telecommunications and Finance, said that he would take no action on the proposal while the issues it addressed were before the court in an ongoing proceeding.

In the Senate, Sen. Al Gore introduced similar, although not identical, legislation. Gore's bill, S. 209, met with the same response as did Tauke-Swift. Sen. Daniel Inouye, Senate Telecommunications Subcommittee Chairman, deferred any action pending the outcome of the Court's deliberations.

A predictable result of the Court's decision was a renewed call from the RHCs, the Justice Department, and the Commerce Department's National Telecommunications Information Administration (NTIA) for the Congress to act. Each, in turn, sharply criticized the Court and mounted a campaign to convince the Congress to take telecommunications policy away from the court and put it back in Congress. NTIA went so far as to ask the FCC to order the RHCs into the full provision of information services, knowing full well that the FCC had no such authority.

NATA aggressively campaigned on the Hill in opposition to any such action. Ironically, and wholly unintentionally, the RHCs themselves contributed to Congressional inaction. The simple fact was that they were not agreed on what exact course of action should be taken legislatively. Additionally, the timing of the calls for action was poor. Congress was awaiting final action by the Court, which did not occur until March 1988. As the Congress looked at the final half of 1988, it was facing a Presidential election, as well as Congressional re-election campaigns. That meant a relatively short legislative session, with a schedule already full with other, essential, business. Coupled with their lack of desire to become embroiled in such a complicated and controversial issue so close to the election, the press of other business made it possible to avoid taking any action.

Late in the second session of the Congress, Bell backers introduced House Concurrent Resolution 339. Introduced on July 14, 1988, by Cong. John Dingell, Chairman of the full House Energy and Commerce Committee, and co-sponsored by others who had supported previous attempts to "Free the BOCs," the Resolution, if passed by both House and Senate, would have put the Congress officially on record as favoring lifting all but the long distance restrictions.

At this writing, no action has been taken on the Resolution. Although its passage would not actually change the law, NATA has joined with numerous in-

dustry and consumer groups in actively opposing any action. Passage of such a measure would signal increased trouble for the competitive industry in the next Congress.

On August 3, the Congress gave its final approval to H.R. 3, the Omnibus Trade Bill. The 1,000 plus-page measure, which was many years in the making, and which covered virtually every aspect of trade policy, essentially tightens up the way in which the U.S. regulates trade. It has been labeled "procedural protectionism" by some, and aptly so. While not mandating that the President ban certain products, or trade with specific countries, it makes it more difficult for a President to ignore or take no action on allegations of unfair trade practices. Investigations of alleged unfair trade practices would occur and if, as a result, it was found that another nation had engaged in such practices, the bill gives the President a series of steps he could take in retaliation.

Of particular interest to the telecommunications industry is the measure's separate telecommunications section. Telecommunications is one of the few industrial sectors singled out in the bill for special treatment. Its main provisions are:

1. The U.S. Trade Representative (USTR) is required to identify and investigate priority foreign countries (i.e., those with the most serious impediments to telecom trade). The list is to be compiled within five months of enactment.

2. The President is required to negotiate with those countries for an opening of their markets. If no agreement is reached within a given period of time (18 months to 3-1/2 years depending upon circumstances) the President is required to take any of a broad range of actions authorized by the bill. The President may modify or terminate any such action under certain circumstances.

3. The USTR is required to conduct annual reviews of foreign telecom trade practices and to take specific actions if a nation is found guilty of unfair trade practices or in violation of any telecommunications trade agreement.

4. The FCC is required to report to Congress data about foreign sales of telecommunications equipment in the U.S. This requirement deals essentially with central office equipment.

Also of general interest, the measure contains sanctions against the Toshiba Corporation for actions taken by a subsidiary, Toshiba Machine (not a telecommunications company), in selling certain equipment to the Soviet Union in violation of the COCOM agreements. Specifically, it prohibits the import into the U.S. of any Toshiba Machine Co. products for three years. It prohibits any U.S. government contracting and procurement with the parent Toshiba Corporation for three years. Exceptions are made for national security reasons, spare parts, routine servicing and maintenance, information and technology, and pre-existing contracts.

FEDERAL COMMUNICATIONS COMMISSION

The FCC underwent a number of changes in the last year, including the appointment of a new Chairman, Dennis Patrick, who replaced Mark Fowler. Patrick, a Fowler protege, was widely expected to continue many of the policies formulated by his predecessor, and he has fulfilled those expectations. Patrick managed to run afoul of Congress early in his term. Relations remained strained at best as Patrick pursued a policy agenda opposed by the Chairmen of the House and Senate Telecommunications Subcommittees.

The Agency has operated for a good portion of this period with two vacancies out of its five commissioner positions. The Administration nominated Susan Wing and Bradley Holmes to fill the vacancies. The Senate, however, has refused to consider their nominations. Fearful that Wing and Holmes would push the Patrick agenda, and hopeful that the Democratic nominee would be elected President in November, Senate Energy and Commerce Committee Chairman Ernest Hollings stalled the nominations.

NATA has been both active and successful during 1987-88 at the FCC. Perhaps nothing has been more successful than NATA's efforts to bolster the Sales Agency program, under which non-Bell companies sell BOC services on a commissionable basis.

By way of brief background, in March 1986, the FCC proposed to eliminate the so-called separate subsidiary requirements under which the BOCs could market equipment only through a wholly separate subsidiary. The FCC proposed allowing the BOCs' regulated side to market equipment, as long as

various non-structural safeguards were in place. The FCC created sales agency, or its "functional equivalent,." as a non-structural safeguard at NATA's urging in order to provide a market check against RHC abuse of its monopoly position. NATA further pushed sales agency as a way of providing some degree of parity for independent equipment vendors in competing against BOC joint marketers.

In mid-1987, Pacific Telesis filed its compliance plan with the FCC showing how it would comply with the FCC's non-structural safeguard requirements as a prerequisite to being allowed to jointly market network services and CPE.

Instead of sales agency, PacTel proposed to establish what it termed joint and intermediary marketing programs. Under intermediary marketing, the telco would simply educate vendors about telco services. Under joint marketing, a few vendors would have been able to market a limited range of telco services to a limited number of customersz. Under neither of the plans would the vendor be paid commissions.

NATA undertook a major educational campaign both with the FCC and the Congress. NATA argued that in no sense was the PacTel plan the equivalent of Sales Agency. In fact, NATA said that the plan was nothing more than an ill-disguised attempt to kill off all Sales Agency programs. Certain of the RHCs had never liked Sales Agency and would jump at any opening to dump the program.

In January 1988, in a major victory for NATA, the FCC ruled against PacTel. The Commission ruled that PacTel's proposal did not meet the test of being a "functional equivalent" of Sales Agency, saying that commissions are a "key benefit" of the programs in that they promote "competitive parity" in the CPE industry. The FCC gave PacTel until February 15, 1988, to come back with its Agency plan. PacTel did so and is hoping to implement its agency program.

In the same order, the FCC generally approved the other RHCs' plans for complying with the non-structural safeguards required for merging CPE sales into the regulated side of the business, including the access telco sales forces would have to their customer proprietary network information (CPNI).

NATA feared that the telco's CPE sales force would have unrestricted access to this CPNI, giving that sales force an unfair competitive advantage over the independent vendor. NATA believed strongly that the telco's customer should have the right to restrict access to this information.

In January 1988, the FCC issued a ruling governing the use of CPNI. The rule ordered the telcos to notify their customers of what would be happening with CPNI. NATA was concerned over many potential loopholes in the requirements placed on the telcos and filed with the FCC asking for an opportunity to comment on the proposed telco notices.

In February 1988, the FCC agreed with NATA. It extended its deadline for customer notification and required the telcos to submit their proposed CPNI notices to the Commission for public comment.

Upon review of the proposed notices, NATA found its earlier concerns justified. The proposed notices were sadly lacking in clarity. The customer would not be informed as to exactly what was at stake and of its importance. In its comments filed with the FCC, NATA asked for several specific changes in the notices. Those changes included:

1. A requirement for more specific definitions in the notices of CPNI, so that the user would clearly understand what was to be transferred.

2. A clear explanation of the implications of such a transfer of information.

3. A requirement that the telco notice reply form include a section in which the user could designate the vendor(s) of his choice to receive CPNI, not just restrict the telco's sales force from receiving this information.

4. A further requirement that the reply form include a specific section allowing the user to restrict the telco from access to his CPNI.

5. A requirement that the notice give the user a date certain for the return of the reply form.

6. A requirement that the notice include a stamped, self-addressed envelope for returning the reply form.

NATA believed that these additions were essential for the user to fully understand his full range of choices and the importance of those choices.

In May 1988, the FCC issued its final CPNI Rule. In it, the Commission included all but one of NATA's requested changes in the notices. The only point not included was the request for a reply envelope.

NATA remains concerned over potential abuses in this area and has gone to great lengths to notify its members of the rules as established by the FCC and of steps they can take to protect themselves and their customers. For example, NATA sent its members form letters for their customers restrict telco CPE marketers from access to this CPNI.

This period saw the FCC give additional clarification to its June 1986 Computer III ruling, which eliminated its earlier Computer II requirement that AT&T and the RHCs have separate subsidiaries to offer "enhanced services." Under Computer III, AT&T and the RHCs would be able to offer a variety of unregulated enhanced services from within their networks. These services, combining computer and communications technologies, include transmission-oriented services, such as protocol conversion, "mailbox" offerings, such as voice mail and electronic mail, and content-specific services, such as electronic database, directory, and transaction services.

Computer III did not, however, immediately free the regulated carriers in this area. At the time of the decision, the RHCs were prohibited under the terms of the MFJ from offering information services. As discussed earlier, it wasn't until March 1988 that the Court authorized these carriers to provide gateway transmission for information services, and the Court has not freed the RHCs to generate or modify information "content."

Secondly, elimination of the separate subsidiary requirement was conditioned by the FCC upon the development and implementation of certain non-structural safeguards designed to prevent abuse of monopoly network control. Those safeguards include "comparably efficient interconnection" (CEI) and "open network architecture" (ONA) requirements, network disclosure rules, CPNI rules, and various cost allocation and accounting rules.

The FCC's stated intention in adopting these requirements was to ensure that all competitors would have full and equal access to the network, under terms and conditions comparable to those enjoyed by the carrier itself.

During 1987-88, much attention was focused on the CEI/ONA requirements. Under these rules, a regulated carrier would be free to offer enhanced services without a separate subsidiary if it had an approved ONA plan in place. In the meantime, the carriers could offer individual enhanced services if they had filed and approved CEI plans.

The term ONA refers to the overall design of the telephone company's network facilities and services. ONA would, theoretically, "unbundle" those services so as to permit all users of the network, including competitors, to connect their equipment with the network in a manner that is technically efficient and that assures that all customers receive equal treatment.

On February 1, 1988, AT&T and the RHCs filed their ONA plans with the FCC. The "building blocks" used to unbundle network services so others can use Bell central offices to deliver information services differ radically from one RHC to another. NYNEX, for example, calls for establishing 14 "basic service arrangements" (BSAs) containing 91 "basic service elements" (BSEs). Ameritech proposes four (4) BSAs containing 21 BSEs.

Numerous parties, including the Administration, through NTIA, have filed objections to the ONA proposals. Opponents claim that the plans fail to insure against cross-subsidization and that equal access is not guaranteed.

At this writing, the FCC has not ruled on any of the ONA proposals, The Commission has testified before Congress that it plans to do so by the end of 1988.

To date, AT&T and the RHCs have filed no fewer than 15 CEI plans and amendments with the FCC. Of those plans, six have been approved. For several of the RHCs, plans have been approved for voice messaging and/or gateway services. AT&T has received conditional approval for two CEI plans covering codec conversion and transaction services. Nine plans, or amendments to plans, were pending at the Commission, as were requests for at least two waivers of the CEI rules.

Another area of interest in which the FCC has initiated action in the past year has been its proposal to junk its traditional rate-of-return tariff regulatory methods in favor of a new price cap method. In August 1987, the FCC proposed abandoning rate-of-

return tariff regulatory methods in favor of a system used in certain European nations known as Price Caps. Under the scheme, a ceiling would be placed on tariffs that could be charged, and the carrier would then be free to earn whatever profits it could within that price cap.

The Commission's initial plan was extremely brief, providing few details as to how exactly the scheme would work. The Congressional reaction was both swift and highly critical, particularly to the short time allowed for comments and replies. The original plan called for comments in October, with replies due in November. Citing the enormous complexity involved in rate regulation, not to mention the potential for abuse under such a new and radical departure from traditional regulation, the Hill lambasted Chairman Patrick in a series of hearings.

As a result of the volume of criticism, the Commission withdrew its original proposal, saying it would come back at a later date with a plan that was "fleshed out." In May 1988, that new plan was revealed. As voluminous as the original was short, the new proposal called for annual rate reductions over a four-year period, based upon new efficiencies which the FCC said could be expected as a result of the new freedom given the carriers.

In a series of hearings in the House and Senate during the Summer of 1988, considerable skepticism remained evident on the part of the Congress. While not rejecting the concept of price caps out of hand, both House and Senate Telecommunications Subcommittees questioned the wisdom of rushing into a new regulatory method which, they maintained, was little understood. Among the concerns raised were whether it was the consumer or the carrier which would actually benefit. If the consumer's bill was reduced by 3%, but the carrier's rate of return doubled, would not the consumer be overcharged? Other questions involved the effect price caps might have on quality of service.

Again, the Congress asked the FCC to slow down to give more time to thoroughly review the plan. At this writing, Chairman Patrick is refusing comment on when the Commission might act, saying that the comment period is not yet over and he won't prejudge the issue. The likelihood, however, is that the FCC will issue a final Price Cap Rule before the end of 1988, in which case, the earliest that the Rule could become effective would be in the Spring of 1989.

APPENDIX B

MACROECONOMIC PERSPECTIVE

Excerpted From NTIA's *Telecom 2000*, October 1988

Economic and Commercial Imperatives

Business-related communications and information usage and expenditures today reportedly represent some 60 percent of the overall market, and are growing faster than individual residential or noncommercial applications. Experts forecast this will continue. The efficiency and other gains associated with the increased application of information technologies, however, should affect various sectors of the business economy differently.

Retailing

Indications are that retailing and associated financial sectors may well be most affected. The infrastructure needed to support pertinent information services is almost fully in place today. For example, most major retailing companies already rely heavily on computerized point-of-scales terminals linked with sophisticated inventory and purchasing systems through communications. Several, such as Walmart and Safeway Stores, have installed private, nationwide satellite communications networks. In addition, although a majority of financial services transactions today may still be accomplished conventionally, measured by number of transactions, and by dollar value, most today are handled electronically. Moreover, as the world's stock markets demonstrated in October 1987, securities trading today is both global and essentially electronic. Information services, in short, have emerged and should become an increasingly important factor of production for retailing and associated financial services generally over the next few years.

Several demographic factors will contribute to this development. Because of low birth rates in the Sixties and Seventies, for example, the U.S. labor pool should be relatively smaller, and thus, some upward pressure on wages should continue for the balance of the century. Some labor economists believe immigration will ease possible shortages of skilled and professional workers, while more restrictive U.S. immigration laws could mean that labor shortages in less skilled positions will not be so readily alleviated. A relative scarcity of entry-level and semiskilled workers, which traditionally have constituted a large portion of the retailing work force, and higher wages rates for those hired, should give business an added incentive to automate electronically, which will mean an even greater reliance on information resources.

Yet another contributing factor will likely be the emergence of an aging, but more affluent U.S. population. The U.S. population on average has been growing older over the past two decades, and this trend is forecast to continue over the next decade. From a median age of 30 years in 1980, the United States should move to a median of 38 by the year 2000. While an aging population ordinarily implies a lessening of demand, particularly for consumer durables, housing, and some other commodities, the fact that disposable household income levels should be higher tends to offset such expectations.

Contributing to the expectation of greater demand (which probably will be reflected in higher retail and service sector sales) are other phenomena. As divorce rates have remained high, and the median age when individuals first marry has grown higher, the incidence of single-individual households, for example, has increased, and that trend is expected to continue. On average, these single-individual households should have substantial disposable incomes.

Relatedly, the number of two-income households should continue to rise steadily, as an increasing percentage of women seek work outside the home. If current trends continue, estimates are that between 65 and 80 percent of working age women will work outside the home by the turn of the century, compared with about 56 percent today. This trend, in turn, should place a premium market value on

timesaving (and thus leisure time-maximizing) goods and services. To date, growth in retail electronic banking and mail order sales, for example, has closely paralleled the rise in the percentage of women working outside the home. Sales of consumer electronics such as microwave ovens, and surges in demand for convenience and fast foods, also reflect this change. Retailers in general can reasonably expect to employ information systems to meet this demand, both by offering "teleshopping" and similar services, and providing customers with new electronics-based product options, for example.

Manufacturing

International competition especially should continue to drive U.S. manufacturing toward increasing reliance on communications and information as a means of stimulating productivity, improved product quality, and innovation. Investment in "information resources" today, as earlier noted, constitutes about 24 percent of annual business equipment investment overall. The primary emphasis in recent years has been on more closely aligning product development, fabrication, distribution, and retailing and by so doing, improving the "through-put efficiency" of firms' overall production processes. Major reliance on computer-aided design, however, also is spreading. In this regard, auto, aerospace, and computer companies today are among the principal users of supercomputers for such purposes. Even in other much smaller and more traditional markets, however, computer-aided design is increasingly prevalent. Both vessels contending in this year's America Cup race, for example, were designed using the same computer software package. The improved management which the intelligent use of information resources allows, moreover, appears to have made commercial operation feasible on a broader scale; in other words, it has tended to raise the level at which any diseconomies of industrial scale and scope become a factor.

Changes in the automobile sector, which reportedly accounts for one in every six American jobs, show this new emphasis in practice. General Motors, for example, in recent years has moved to develop sophisticated computer and communications systems linking thousands of design and manufacturing facilities, retailing outlets, maintenance centers, and suppliers worldwide. Ideally, the new car purchaser in the near future will order a specific model, specifically equipped; that requirement will be entered into a communications and computer information system; requisite materials, in turn, automatically will be ordered from suppliers (or an existing vehicle in inventory meeting the demand located); production and delivery scheduling will then be accomplished in substantially less time. A primary objective is to reduce inventory and associated financing costs to a minimum. When serviced, moreover, centralized diagnostic systems will be increasingly employed on new cars. Manufacturer and dealer computers will be increasingly linked via communications. On-demand fabrication of special parts also will be feasible using computer-aided flexible manufacturing, thus sharply reducing delay and inventory costs.

More sectors of the manufacturing economy today rely on information systems to greatly reduce the amount of slack and downtime often characteristic of traditional production processes. An advantage has been to offset and help justify higher U.S. manufacturing wage rates; but the increasing reliance on computers and communications by foreign competitors has also made increasing automation by U.S. firms essential if they are to maintain their global competitiveness. Also contributing to demand, particularly for international telecommunications, has been the emergence of distributed global manufacturing by multinational corporations as a dominant commercial reality. Today, virtually all but the lowest value-added electronics products, for example, incorporate parts made in one country, assemblies and subassemblies produced in another, and involve final product fabrication accomplished in yet another. The same is true in the apparel, aerospace, and auto businesses. International telecommunications is essential to the smooth and efficient choreographing of such complex manufacturing processes.

In addition to these applications, U.S. manufacturers have made substantial strides in the use of communications and computers to facilitate the design of better products. By linking computers used in design and engineering via communications, the production of advanced, energy efficient jet engines, for example, has been facilitated. Without such "electronic tools," the necessary engineering and drafting tasks might well have proven impossible.

Manufacturing remains a cornerstone of the U.S. economy. Many of the highest value-added parts of the overall services economy–producer services such as banking and finance, engineering, and the like–are also heavily dependent on our domestic manufacturing sector. Manufacturing, moreover, is a sector in

which investment in computer and related telecommunications products can be shown to have yielded commensurate productivity gains in the near term.

Greater reliance on information resources by U.S. manufacturing should generate a variety of spin-off effects. It will, for example, increase demand for higher skilled workers as well as necessitate further training of existing employees. Those are tasks which can be more efficiently accomplished, in turn, by using telecommunications, as indeed is currently the case. The depth and abundance of any given community's overall information resources portfolio should also play an increasing role in business plant sitting decisions. In the past, it was the availability of transportation and labor resources, for instance, which often was decisive. Increasingly, the information infrastructure which a manufacturer requires should become increasingly significant in such facilities location decisions.

The availability of electronic information assets for business applications is likely to prove more critical. In addition, as telecommunications goods and services come to constitute a larger element of what constitutes a better standard of living, some employers may factor in employee access to the latest technologies when reaching facility location decisions. Similarly, as differentials between the communications and information choices in urban, suburban, and rural areas narrow, as they are likely to do, a dispersion of economic enterprises (as well as the revitalization of some now less prosperous areas) is more likely to occur, as more fully discussed in Chapter Four.

Service Industries

Information resources should also become an increasingly important production component for the service industries which today comprise nearly three-quarters of the U.S. economy. This growing reliance likely will prove a function, in part, of a relative labor scarcity and thus higher wage costs. It will also, however, reflect the fact that, in labor-intensive service sectors, telecommunications and computer services are among relatively few proven means of boosting productivity.

This reliance on electronic tools to boost productivity, while maintaining and improving product quality, should especially affect demand for radio frequency-dependent communications goods and services. Current services such as cellular mobile radio and paging offerings already are integral value-producing components of many service sector endeavors. As equipment prices continue to decline, and service costs fall as a function of greater communications traffic volume, mobile radio services stand to become even more ubiquitous. More intensive use of the radio spectrum, coupled with the larger commercial stakes of users, in turn should complicate spectrum management tasks and possibly move the current regulatory approach toward one that offers substantially greater flexibility and efficiency.

Telecommunications and information systems almost certainly will constitute a more important production factor in parts of the economy not typically regarded as service industries. Among the businesses most affected by these technologies, for example, have been printing and publishing. Virtually every major daily newspaper in the United States today is created and printed using computers, with many papers also operating satellite printing presses linked via communications in order to reduce distribution costs. The two largest U.S. dailies, the *Wall Street Journal* and *USA Today*, are prepared and printed on a national, indeed, international scale via computer and communications. Europe's leading financial daily, the *London Financial Times*, is also "imported" via satellite into the United States, just as *USA Today* is electronically "shipped" to Europe. Transportation, rail, air, and water carriers are already among the largest communications and information system users. Nationwide paging and satellite-based mobile radio should become increasingly important to motor common carriers as well, especially as higher energy costs and environmental concerns necessitate more efficient operations.

Not only will telecommunications and information thus constitute a larger factor of production for familiar and other service sector industries, but electronic information services themselves should become a substantially larger part of the U.S. economy. Remote-access data retrieval and data processing, interactive computer data bases, and so-called "electronic publishing" enterprises already account for some $4 billion in yearly revenues. Estimates are they will continue to grow at about a 20 percent compounded annually for the indefinite future.

Demand for such new services should swell, as a function of demographic forces. By the mid-1990s, at least one-third of U.S. households likely will be headed by computer-literate individuals. About 15

percent of American households have home computers at their work place. In the past, individuals may have been reluctant to make the time investment needed to become computer literate. For a growing number of Americans, however, the cost of acquiring knowledge and ability will shrink rapidly. Together with incentives to maximize leisure time through use of time-saving measures, a predictable result will be an accelerating growth of this information services sector.

Converging Forces For Change

Commonplace is the contention that technology alone contributed to the substantial changes experienced in communications markets over the past 20 years. Certainly technologies have created a gravitational pull on regulatory structures based on technological foundations which have crumbled. But technology alone has not been responsible for change.

Government policy can dramatically affect the pace with which technology is developed and deployed commercially. A wide variety of economic, business, demographic, and other factors typically bear heavily, if not decisively, on any industry's development and performance. In this part, therefore, technology as well as other forces which converged to cause changes in communications markets over the past few decades are briefly reviewed and discussed.

Fundamental Technologies

Fundamental to the changes occurring in almost all communications markets was the advent of microelectronics, a technology pioneered in the 1950s by AT&T Bell Labs. Microelectronics -- the popular "silicon chip" -- functioned as both a major demand-inducing and cost-reducing building block for change, and one which has proven amendable to ubiquitous application.

The initial practical application of this technology occurred largely under government auspices, particularly as part of the NASA space effort. Microelectronics rapidly spilled over to ever-widening commercial use, however, which, in turn, caused major communications industry changes.

Widespread application of microelectronics by the computer-data processing industry caused rapid growth in the number of computer installations. That, in turn, created new user demands for digital communications and terminal equipment different from that which established telephone companies were then willing to supply. Unlike some previous technologies, furthermore, knowledge regarding the potential of microelectronics was widely dispersed. Many, in addition to the traditional telephone industry suppliers, and some with an aggressive, entrepreneurial approach new to telecommunications generally, began commercial exploitation of microelectronics by the seventies.

In the 1970s, computer processing costs plummeted. That contributed to a proliferation of units and an expansion in their computational capabilities, with attendant "demand-pull" effects on the telephone and other industries. Additionally, the application of this technology in communications sectors led to new products and services.

Microelectronics made mini-cameras and an array of other products feasible in broadcasting which, in turn, revolutionized the economies of both program production and distribution. The technology made increasingly efficient satellite communications systems possible. It resulted in computerized telephone switches; those, in turn, made computer-controlled mobile radio offerings–today's popular "cellular radio"–technologically possible. Including a "processing" capability in other radio transmitting and receiving equipment made it possible to send more messages and information using the same or less radio spectrum. Importantly, the synergistic interplay of computers and communications, in turn, accelerated the pace of change.

Through computers and communications, researchers gained faster access to more and more information. They also acquired ready means more effectively to build on previous research results. The example of commercially feasible fiber optic communications is a prime case in point.

That lightguides could, in theory, provide very broad-band, high-capacity communications links was well known among researchers in the 1950s. It was not until about 1970, however, that researchers had the electronic tools available to explore methods of practically applying lightguide theory. Fiber optics, in essence, entails advanced chemistry applications and

chemistry relies heavily on mathematics. Efficient and effective computers, facilitated by microelectronics, made possible the mathematical computations which, in turn, made possible the advances in chemistry which, again in turn, produced workable fiber optics.

Microelectronics thus led to this marvelous new technology and its commercial application. Microelectronics, incorporated into computers and aiding in sophisticated communications, also produced widespread dispersion of the original research demonstrating the means of making fiber optics and the necessary advanced lasers. One researcher's findings, moreover, could rapidly be built upon by others. Consequently, the United States was able to experience the progress of a pivotal new technology from the fundamental research laboratory to nationwide fiber optic networks in a relatively short time.

Commercial Dynamics

Contributing heavily to the rapid development of microelectronics and the communications applications relying on that new technology were fundamental shifts in the nature of commercial demands.

When the Rostow Task Force was deliberating, the United States was as a former Treasury Secretary put it, "an economic Gulliver standing astride a world filled with Lilliputians." U.S. manufacturing output in the late 1960s nearly equalled that of the rest of the Free World combined. Buttressed by cheap energy, favorable tax policies, relative freedom from environmental and other social policy impositions, and buoyed by fast growing domestic markets, U.S. business and industry experienced unparalleled profitability. Imports and exports represented less than 10 percent of the U.S. GNP combined.

Conditions and commercial circumstances began changing at an accelerating pace, however, shortly after issuance of the Task Force's report. Inflationary pressures produced international financial change. Contemporaneously, the sometimes painful process of integrating the United States commercially into the world economy began. Parts of our economy slowed, while interest and inflation rates soared. Greater and better import competition, a desire to maintain profit margins in the face of dwindling domestic markets, and inflationary pressures all have more recently prompted actions by major U.S.-based firms.

First, new cost-reducing measures were explored and adopted, and communications and computer-data processing figured heavily in this. Second, a number of businesses adopted "forward defense" policies by seeking to expand their domestic operations to compete more aggressively abroad. This strategy was pursued especially by U.S.-based financial services companies, which moved rapidly into the less regulated world financial markets which the elimination of fixed exchange rates and resulting expansion in world trade activity helped cause.

Greater commercial use of and reliance upon communications and information resources was a prime driving force behind the fast growth in domestic and international telecommunications markets which the United States experienced. Communications companies strived especially to meet the new demands of their major customers. This phenomenon, moreover, extended beyond simply communications common carriage. In broadcasting, for example, local stations moved to exploit the new service capabilities of microelectronic-dependent technologies. Electronic news gathering systems made possible new local and other coverage that attracted audiences. Contemporaneously, the computerization of the advertising business, mentioned above, made it possible for local stations–increasingly competitive factors in national ad markets–both to fund new services initially and subsequently to capitalize commercially on the new audiences which those services delivered.

Cable television growth was fueled by this new technology and the profit opportunities it afforded. Satellite communications made nationwide pay cable television networks commercially feasible. The earnings that resulted, in turn, made rapid expansion of cable television systems and rising household penetration possible. That increased penetration made feasible the increasing number of new program services which have so substantially contributed to national diversity. Radio also capitalized on satellite communications. That technology made it feasible for station to reduce some costs while adding new services.

As communications markets in general became more competitive, and firms sought to match the communications and information resource capabilities that their competitors enjoyed, the rate of change accelerated. Once a critical mass of firms in an industry adapted to these new technologies, others moved

rapidly to incorporate them into their way of doing business as well.

American Demographic Changes

At precisely the same time new, microelectronics-based communications and information systems were materializing, and the business community was moving to exploit more effectively those systems' capabilities, fundamental changes were taking place in the U.S. population which tended to drive the process of change forward.

First, and most notably, the population of the United States grew substantially. In 1988, there were some 44 million more Americans than in 1970: growth representing the equivalent of two-thirds the total current population of West Germany. Increased population, particularly in densely inhabited urban areas where some three-quarters of Americans now live, increased demand for a variety of services that were communications dependent.

Between just 1980 and 1984, for example, total law enforcement expenditures by all governments grew some 80 percent (to about $40 billion from $22 billion). During that same period, Federal law enforcement expenditures increased 128 percent. There was an 86 percent increase in state and a 69 percent increase in local law enforcement budgets. Reliance upon radio and other communications resources by law enforcement and other public health and safety agencies experienced commensurate increases, which both stimulated demand for equipment and increased overall radio frequency management challenges.

Second, population growth as well as changes in certain key sectors also increased demand for government services. Especially since the removal of economic regulation of the commercial air cargo and passenger businesses in the late 1970s, for example, there has also been a surge in air transportation, and a corresponding increase in demand for the communications and information systems needed to manage this traffic. In 1970, only about 10 percent of the population had flown commercially during the preceding three years. Last year, nearly one-third of the American public reportedly took a commercial flight. There were some 450 million domestic boardings in 1987, and some 12,000 takeoffs and landings every day. Again, much greater demand for communications and information processing was a clear result.

The period after 1970 also saw substantial increases in U.S. individual income and expenditure levels. Between 1970 and 1985, per capita income rose about 30 percent and per capita expenditures rose about 34 percent, measured in constant 1982 dollars. Increased propensity to consume fueled increased spending on advertising, which caused, in part, substantial changes in the broadcasting business.

In addition, there were predictable changes in the magnitude and character of demand for other communications services. Most basic communications requirements–universal basic telephone service, for example–had been met in the early 1970s, if not somewhat before. The market's priorities, therefore, shifted from meeting basic customer needs to satisfying new customer desires. Additionally, as an increasing number of women worked outside the home, demand for time-saving measures grew. The rapid growth of retail electronic banking and telephone order sales was a result. More spending in general, plus spending on communications and related products in particular, had a significant effect on the development of telecommunications markets.

Contributing to the rapid development of telecommunications markets, as well as the advances in technology seen during the post-1970 period, was the national investment in education begun in the late 1950s and 1960s. Total U.S. expenditures on education and training rose from some $24.7 billion (5.1 percent of GNP) in 1960, to $163 billion (8.6 percent of GNP) in 1978. Despite declines in the school age population, expenditures increased to $244 billion (6.1 percent of GNP) in 1985. The number of institutions of higher learning expanded from 2,566 spending $23.4 billion in 1970 to 3,331 spending $82 billion in 1984. The national median years of school completed rose from only 10.6 years in 1960 to 12.6 years in 1980.

APPENDIX C
CONTACTS FOR DATA USERS

Federal Communications Commission
1919 M Street, N.W.
Washington, DC 20554
(202) 632-5050

National Association of Regulatory Utility Commissioners (NARUC)
1102 Interstate Commerce Commission Building
Constitution Avenue & 12th Street, N.W.
P.O. Box 684
Washington, DC 20044
(202) 898-2200
Mission: Represents the state public utility commissions in Washington, DC.

National Exchange Carriers Association
100 South Jefferson Road
Whippany, NJ 07981
(201) 884-8000
Mission: Set up by Federal Communications Commission to administer expenses of former AT&T companies.

National Science Foundation
1800 G Street, N.W.
Washington, DC 20550
(202) 655-4000

North American Telecommunications Association
2000 M Street, N.W.
Suite 550
Washington, D.C. 20036
(202) 296-9800

Office of the United States Trade Representative
600 17th Street, N.W.
Washington, D.C. 20506
(202) 395-3204

U.S. Congress
Office of Technology Assessment
600 Pennsylvania Avenue, S.E.
Washington, DC 20510
(202) 228-6760

U.S. Department of Labor
Bureau of Labor Statistics
200 Constitution Ave., NW
Washington, DC 20210
(202) 523-1327

U.S. House of Representatives
Energy and Commerce Committee
Telecommunications, Consumer Protection, and Finance Subcommittee
B333 Rayburn House Office Building
Washington, DC 20515
(202) 225-9304

U.S. International Trade Commission
500 E Street, S.W.
Washington, DC 20436
(202) 252-1819

U.S. Department of Agriculture
Rural Electrification Administration
12th & Independence Avenue, S.W.
Washington, DC 20250
(202) 382-1255

U.S. Department of Commerce
Bureau of the Census
Industry Division
FOB 3
Washington, DC 20233
(301) 763-5850

U.S. Department of Commerce
Bureau of Economic Analysis
1401 K Street, N.W.
Washington, DC 20230
(202) 523-0777

U.S. Department of Commerce
International Trade Administration
Office of Telecommunications
14th Street & Constitution Avenue, N.W.
Washington, DC 20230
(202) 377-4466

U.S. Department of Commerce
National Telecommunications and Information Administration
14th Street & Constitution Avenue, N.W.
Washington, DC 20230
(202) 377-1551

U.S. Department of Commerce
National Telecommunications and Information Administration
Institute for Telecommunications Sciences
325 Broadway
Boulder, CO 80303
(303) 497-3484

U.S. Department of Education
Office of Vocational & Adult Education
Room 615, Reporters Building
Seventh & D Streets, S.W.
Washington, DC 20202-5613
(202) 732-2432

U.S. Department of Education
Information Resource Management Services
Room 4654, Regional Office Building 3
Seventh & D Streets, S.W.
Washington, DC 20202-5613
(202) 732-2174

U.S. Department of State
Bureau of International Communications and Information Policy
National Committee for the CCITT
2201 C Street, N.W., Room 6317
Washington, DC 20520
(202) 647-5727

U.S. Information Agency
301 4th Street, S.W.
Washington, DC 20547
(202) 485-7700

U.S. Securities and Exchange Commission
450 5th Street, N.W.
Washington, DC 20549
(202) 272-2000

APPENDIX D

GLOSSARY

A AND B SIGNALING – Procedure used in most T1 transmission facilities currently operated by U.S. telephone companies, in which one bit, robbed from each of the 24 subchannels in every sixth frame, is used for carrying dial and control information. A type of in-band signaling used in T1 transmission.

ABANDONED CALL – Call in which a caller cancels the call after a connection has been made, but before conversation takes place for example, after hearing a recorded announcement.

ABBREVIATED AND DELAYED RINGING – Allows the ringing associated with a call on a station line to be transferred to another station that has an appearance of that line. The transfer occurs automatically after two ringing cycles.

ABBREVIATED DIALING – A feature where the user can effect dialing of stored, called numbers by using a two-, three-, or four-digit code instead of the entire seven or ten digit number. Also called speed dialing.

ABOVE 890 DECISION – 1959 FCC ruling on private, point-to-point microwave links, which established a bandwidth spectrum for use by businesses wanting to bypass the carrier long-distance network and provide their own microwave transmission systems.

ACCEPTANCE TEST – Operating and testing of a new communications system to ensure that it is operating satisfactorily before being accepted by the purchaser.

ACCESS CHARGE – Cost to user for access to interexchange, interstate message toll telephone network to originate and receive interstate toll calls, as well as interexchange carrier access to the users' Local Access and Transport Area (LATA).

ACCESS CODE – Extra digit or digits that a PBX extension user must dial to obtain a specific service.

ACCESS METHOD – The technique and/or the program code in a computer, operating system that provides input/output services. By concentrating the control instruction sequences in a common subroutine, the programmer's task of producing a program is simplified. The access method typically carries with it an implied data and/or file structure with logically similar devices sharing access methods. The term was coined, along with data set, by IBM in the 1964 introduction of the System/360 family. It provides a logical, rather than physical, set of references. Early communications access methods were primitive; recently they have gained enough sophistication to be very useful to programmers. Communications access methods have always required large amounts of main memory. In a medium size system, supporting a few dozen terminals of dissimilar types, 80K to 100K bytes of storage is not an unusual requirement.

ACCESSIBILITY – Number of trunks in the route of a network which can be reached from an outlet.

ACCOUNTING RATE – Charge per traffic unit, which can be a unit of time or information content, covering communications between zones controlled by different telecommunications authorities; used to establish international tariffs.

ACCURACY – Frequently confused with precision, accuracy refers to the degree of closeness to a "correct" value. Precision refers to the degree of preciseness of a measurement. A mathematical algorithm may give a result to 10 decimal places (high precision), but be reliable (accurate) to only five places, if it is poorly designed. (Precisely or precisely defined, although similar in sound to precision, is closer in meaning to accuracy.)

AC-DC RINGING – A type of telephone signaling that uses both AC and DC components – alternating current to operate a ringer and direct current to aid the relay action that stops the ringing when the called telephone is answered.

ACF – Advanced Communications Function, a series of software

products by IBM for the System/370 computer family. Basically, full front end communications processing is implemented, which allows access to resources of multiple, geographically remote computer systems from one terminal.

ACKNOWLEDGE (ACK) – Protocol control character sent by a receiver as an affirmative response to a sender acknowledging receipt of a transmission.

ACOUSTIC COUPLER – Device that allows a telephone handset to be used for access to the switched telephone network for data transmission. Digital signals are modulated as sound waves and data rates are typically limited to about 300 bps, some up to 1.2K bps.

ACTIVITY FACTOR – The percentage of time during the busiest traffic hour that a signal is present in a channel in either direction.

ACU – See automatic calling unit.

ADAPTER – Device used to enable the compatibility between two diverse pieces of equipment.

ADAPTIVE – There are many characteristics, logical and physical, of a computer and communications system that cannot be specified with high accuracy before the actual installation is made. Adaptive refers to a capability for accommodating a wide variation in one or more system characteristics and still performing the intended function. The word implies that the adjustment is made automatically. Adjustable is frequently used if manual twiddling is required. Adaptive is most frequently used with respect to modems to indicate an automatic accommodation of line characteristics variations.

ADAPTIVE ROUTING – Routing that automatically adjusts to network changes such as altered traffic patterns or failures.

ADCCP – Advanced Data Communications Control Procedure develop by ANSI. It is a bit oriented protocol.

ADD ON CONFERENCE – Sometimes referred to as "3-way calling," used in association with CONSULTATION HOLD features. A station conference facility allowing the station user to selectively (by dialing) add another internal part to the existing conversation.

ADDRESS – In computerese, a location that can be specifically referred to in a program. It can refer to a storage location, a terminal, a peripheral device, a cursor location, or any other physical item in a computer system. It is also the part of a to/from terminal message that contains the identification of the terminal. Coded representation of the destination of call or of its originating placed.

ALARMS SIGNALS TO STATIONS – Indicates the ability of the system to interface with various types of signaling systems and to transmit such alarms in the form of coded tones to all or preselected stations.

ALGORITHM – A logical or mathematical model that incorporates a specific set of rules that tell how information is to be manipulated to give a desired result. It is a fancy word for model. Distinguishing between the model and the real situation is critically important, because the differences often explain why a properly executing program gives erroneous or non-useful results.

ALL NUMBER CALLING (ANC) – Calling by means of seven digits instead of the previously used two letters plus five digits.

ALL TRUNKS BUSY (ATB) – A condition in which all trunks in a given trunk group are busy.

ALTERNATE ROUTING – A feature that gives the switching system the responsibility to select the most economical circuit to use on outgoing calls initiated by stations.

AMERICAN TELEPHONE AND TELEGRAPH COMPANY (AT&T) – The parent company of AT&T Communications, the largest U.S. long-distance provider (formerly known as Long Lines), and AT&T Technologies, which includes both a manufacturing division (formerly known as Western Electric) and AT&T Information Systems, an unregulated customer premises equipment and enhanced services marketing subsidiary. Prior to its court-ordered divestiture in 1984, AT&T was also the parent of the Bell operating companies.

AMPLIFIER – Used to boost sound in analog systems.

AMPLITUDE – Magnitude or size. In waveforms (signals if you prefer) occurring in a data transmission, the waveform can be completely defined if the voltage

level is known at all times. In this case, the voltage level is called the amplitude. The word is a handy, and elegant, way of referring to the magnitude of something.

ANALOG TRANSMISSION – Transmission of a continuously variable signal as compared to a discrete (digital) one.

ANCILLARY EQUIPMENT – Equipment added on to a basic telephone system to provide enhanced features.

ANSI – American National Standards Institute. A highly active, if not speedy, group affiliated with the International Standards Organization (ISO). Accepted and proposed standards include transmission code and protocol (ASCII), media (tape and diskette), and languages (FORTRAN and COBOL).

ANSWER BACK – A manually or automatically initiated reply message from a terminal, which usually includes the terminal address to verify that the correct terminal has been reached and that it is operational.

ANSWER SIGNAL – Signal sent in backward direction when a call is answered. It is used to begin calculation of the call charge to the calling party.

AREA CODE – Part of the national numbering plan, the area code is the first three digits of a subscriber's telephone number, which identifies a specific region of the country.

AREA CODE RESTRICTION – The ability of the switching equipment to selectively identify 3-digit Area Codes, and either allow or deny passage of long distance calls to those specific Area Codes.

ARQ – An error control techniques that requires re-transmission of a data block that contains detected errors. It requires positive (ACK) and negative (NAK) responses from the receiving terminal. A special form, called "go-back-in" allows multiple blocks to be acknowledged with a single response.

ASCII – American Standard Code for Information Interchange. Also called USASCII in an attempt to follow the several name changes of the USA standards body; the last name change to ANSI was not followed. Although adopted in the early 1960s as a universal computer and communications code and, for a while, strongly supported by the U.S. government, the code has had limited usage outside of teleprinters and display terminals by vendors other than IBM (who has supported the code to some degree). Possibly, the code has survived because of the large Teletype teleprinter user base. Originally, it was a seven-level code. Later, an eighth bit was added, usually to represent character parity. Now, parity is a standard part of the code.

ASR – Automatic Send Receive. A teleprinter terminal with paper tape or magnetic tape devices. By extension, it refers to any keyboard terminal with offline storage capabilities that permit a message to be generated off-line for later transmission. Typically, received messages can be permanently recorded.

ASYNCHRONOUS TRANSMISSION – A communications system in which units of data are sent a character at a time preceded and followed by start/stop signals which provide timing at the receiving terminal. Also called start/stop transmission.

AT&T – See "American Telephone and Telegraph Company."

AT&T COMMUNICATIONS – AT&T's long-distance telephone operations.

AT&T INFORMATION SYSTEMS (AT&T-IS) – The unregulated subsidiary set up by AT&T to market customer premises equipment and enhanced services after January 1, 1983.

AT&T LONG LINES – AT&T's pre-divestiture long-distance telephone operations, renamed AT&T Communications after the MFJ took effect in 1984.

ATTENDANT – Usually refers to a local switchboard operator, for example, on a PBX.

ATTENDANT ACCESS LOOP – One of a group of switched circuits, which may or may not be assigned to a specific telephone number, that provides a manual means for call completion and control.

ATTENDANT BUSY LAMP FIELD – Lamps provided on Direct Station Selection (DSS) Consoles behind each station pushbutton or a Digital Display on non-DSS consoles that serve to indicate the busy status of the station. Larger systems utilize 100 or more lamps on the display panel, with the "hundreds"

group of station busy lamp conditions being selected by an appropriate pushbutton on the console.

ATTENDANT CAMP-ON – If an incoming outside call attempts to be completed to a busy station line within the system, it is automatically placed in a special "waiting" mode until the desired station becomes idle. Then the called station is automatically rung and connected to the incoming call upon answer.

ATTENDANT CLASS OF SERVICE DISPLAY – Displays on the attendant console the class of service numerical designation of the station calling the attendant on an ATTENDANT DIAL "O"TRUNK.

ATTENDANT CONFERENCE – Feature that allows the attendant to establish a conference connection between central office trunks and internal stations.

ATTENDANT CONSOLE – A centralized operator position, either desk-top mounted or floor mounted, which utilizes pushbutton keys for all control and call connecting functions.

ATTENDANT CONTROL OF TRUNK GROUP ACCESS – The attendant can control and restrict the access by all stations to various trunk groups by either operating a key or dialing a code. All calls so restricted are usually routed to the attendant.

ATTENDANT DIRECT PAGING – Direct access control(s) are provided on the console or cord switchboard for voice paging.

ATTENDANT DIRECT STATION SELECTION – The facility provides the attendant with one pushbutton for each internal station. The attendant places or completes incoming calls by depressing the pushbutton associated with the desired station.

ATTENDANT FORCED RELEASE – An attendant-activated (pushbutton) facility, which will automatically "disconnect" all parties on a given circuit when that circuit is "entered" by the attendant and this facility engaged.

ATTENDANT INCOMING CALL CONTROL – This facility diverts incoming trunk calls automatically to a predetermined station after a predesignated period of time (or number of rings).

ATTENDANT LOCKED LOOP OPERATION – Allows the attendant at a console to retain supervision or recall capability of any particular call which she has processed.

ATTENDANT LOOP TRANSFER – Allows the attendant to transfer any call to another attendant for processing.

ATTENDANT MONITOR – A special attendant circuit which allows "listening in" on all circuits with the console handset/headset transmitter deactivated.

ATTENDANT OVERRIDE – A feature that allows an attendant to enter a busy trunk connection and key the trunk number within the PBX. A warning tone will be heard by the connected parties, after which the connected parties and the attendant will be in a three-way connection.

ATTENDANT POSITION – Part of a switching system where an operator has the facilities to control or assist users in call completion and special services.

ATTENDANT REPERTORY DIALING – Single pushbutton selection of repeatedly used preprogrammed numbers for outgoing calls made by the attendant on central office trunks.

ATTENDANT RESTRICTION – The attendant is denied the ability to gain access to a trunk in order to originate a call (or to prevent "listening in") unless her assistance is required by station recall.

ATTENDANT STATION BUSY LAMP – When the desired station number is keyed by the attendant, a lamp will light, providing positive visual busy indication.

ATTENDANT STATION NUMBER DISPLAY – Visually displays at the attendant console the station calling number on an attendant trunk.

ATTENDANT SUPERVISORY CONSOLE – A special attendant console used by the "chief" operator of large PBX systems providing, in addition to standard console operation, certain monitoring and control functions over the other consoles.

ATTENDANT TRANSFER OF INCOMING CALLS – Allows the station user, while connected to an incoming outside call, to signal the attendant by flashing the switchhook to allow the attendant to transfer the call to another station.

ATTENDANT TRANSFER – OUTGOING – Permits the attendant to be recalled and to transfer a central office call originated by an internal station.

ATTENUATION – The difference between transmitted and received power due to loss through equipment, lines, or other transmission devices. It is measured in decibels.

AUDIBLE RINGING TONE – Tone transmitted to the calling telephone indicating that the called telephone is being rung.

AUTOMATIC ATTENDANT RECALL – When a possible second transfer is required, the station user depresses switchhook, and the attendant is automatically recalled to further process the outside line to another internal station.

AUTOMATIC CALL DISTRIBUTOR (ACD) – System used to uniformly distribute a large volume of incoming calls to a number of operators as soon as they have a free line. Often used by businesses with a large number of incoming calls such as airlines and insurance companies.

AUTOMATIC CALLBACK – A feature that enables a user with a busy line to be connected automatically to the called line when it becomes idle.

AUTOMATIC CALLING UNIT – A unit that automatically dials calls based on digits supplied by the attached business machine. It is used to implement polling techniques by using the public telephone network.

AUTOMATIC CIRCUIT ASSURANCE (ACA) – A feature that assists the customer in identifying possible trunk malfunctions. The PBX maintains a record of the performance of individual trunks relative to short hold time (SHT) and long hold time (LHT) calls. A significant increase in the number of short calls or a single long call can indicate a trunk failure. When a possible failure is detected, a referral call is initiated to the attendant.

AUTOMATIC DIALER – Device that allows a caller to push one preprogrammed button instead of 7 or 10 numbers.

AUTOMATIC EXCHANGE – Central office through which communication between subscribers is affected without the intervention of an operator, by means of an electronic switching device.

AUTOMATIC EXCLUSION – The first station which accesses a line and prevents any other station from gaining conversational access to that line.

AUTOMATIC HANDS-FREE TALKBACK – On stations which have built-in speakers, this facility allows direct access to a given station via the intercom facility when that station is busy on an "outside" call.

AUTOMATIC HOLD – Allows the attendant to go from one trunk call to another on the console without using a "hold" button.

AUTOMATIC IDENTIFICATION OF OUTWARD DIALING (AIOD) – Hardware system or PBX feature that automatically obtains the identity of a calling station over a separate data link for the purpose of automatic message accounting.

AUTOMATIC LINE HOLD – As long as a station does not go "on-hook," activation of various line pushbuttons will automatically place the first line in hold condition without the use of special "hold" button.

AUTOMATIC NUMBER IDENTIFICATION (ANI) – A service feature whereby the directory number or equipment-number of a calling station is obtained automatically, for use in message accounting.

AUTOMATIC RECALL – Automatically alerts the attendant, after a prescribed period of time, to a camped-on or unanswered call completed through her position so that she might be able to give a status report to the calling outside party.

AUTOMATIC RING-DOWN CIRCUIT – A private line that provides an automatic connection between two points whenever the telephone handset is lifted off-hook.

AUTOMATIC ROUTE SELECTION (ARS) – System which provides routing of certain outgoing calls over alternative trunk facilities, based on direct dialing numbers. The Private Branch Exchange routes the call on the first available trunk facility using a subscriber-specified sequence usually over the least cost route for the type of call initiated.

AUTOMATIC TIME-OUT ON UNCOMPLETED CALL – If a station stays "off-hook" without dialing for a predetermined time

interval, or stays connected to a busy signal longer than the predetermined time interval, the intercom switching equipment will automatically connect this station to an intercept position.

AUTOVON – A voice communications system operated for the United States Department of Defense.

AVAILABLE Line – A circuit between two points that is ready for service but idle.

AVERAGE CUSTOMER ARRIVAL RATE – Represents the number of entities (humans, packets, calls, etc.) reaching a queuing system in a unit of time. This average is denoted by the greek letter lambda. More generally one would prefer to know, if possible, the full distribution off the arrival process.

AVERAGE NUMBER OF CUSTOMERS IN THE SYSTEM – Average number of customers being served plus those in an actual queue. Denoted by the letter L.

AVERAGE QUEUE LENGTH – Average number of customers actually in a queue (omits those currently being served). Denoted by the letter L_q.

AVERAGE SERVICE RATE – The average number of customers that can be served by a server per unit time. Denoted by the greek letter mu.

AVERAGE TIME REQUIRED TO COMPLETE SERVICE – Average total time spent waiting for service. It includes the time in the queue plus the time to be actually served. It is denoted by the letter W.

AVERAGE TIME SPENT IN THE QUEUE – Average time spent waiting to move through a queue, prior to stepping into service. Denoted by the letter W_q. It is one of the measures-of-effectiveness which you want to derive.

BACKBONE NETWORK – Transmission facility, or arrangement of such facilities, designed to interconnect lower speed distribution channels or clusters of dispersed users or devices.

BACKGROUND MUSIC – An optional facility, provided through the switching equipment and associated with special stations with paging speakers.

BACKGROUND MUSIC THROUGH STATION INSTRUMENTS – Provided with systems utilizing built-in speakers.

BAND – 1) The range of frequencies between two defined limits. 2) The specific geographic area which the customer is entitled to call in a Wide Area Telephone System (WATS).

BANDPASS LIMITER – A device that imposes hard limiting on a signal and contains a filter that suppresses the unwanted products of the limiting process.

BANDWIDTH – The range of frequencies available on any message transmission media, whether copper cable or satellite links.

BASEBAND SIGNALING – Transmission of a digital or analog signal at its original frequencies. The signal is in its original form, not changed by modulation.

BASIC RATE INTERFACE (2B + D) – One level of service planned for ISDNs. Allows two voice connections (or one voice and one data connection), or two data connections over the B-channels (64K bps), along with one or more low-speed, packet-switched data or telemetry exchanges over the D-channel.

BATCH PROCESSING – Technique of grouping similar data applications for input and processing in sequential order.

BAUD – A unit of signaling speed. The speed in baud is the number of discrete conditions or signal elements per second.

BAUDOT CODE – Data code using a five-bit structure. Two of the possible 32-bit patterns are used to indicate case shift, which doubles the interpretations of the remaining bit patterns. Actually, an additional four characters are reserved for control functions, limiting the number of data characters to 52. The advantage of having fewer bits per character is offset by the need to transmit the case shift characters.

BCD CODE – Data code using a six-bit structure. The name comes from Binary Coded Decimal, an early, popular computer data code in which the bit patterns for the decimal digits had a binary value corresponding to the digits.

BDLC – Burroughs Data Link Control, a bit oriented protocol.

BELL OPERATING COMPANY (BOC) – One of 22 Bell telephone companies whose primary business is providing local telephone service to cus-

tomers. They are allowed to market, but not manufacture, new equipment.

BID – An attempt to gain control over a line in order to transmit data. Usually associated with contention style of sharing a single line among several terminals. Non-uniform time-outs at each terminal for reinstituting a bid if the line is busy give assurance that each terminal can have access to the line.

BINARY SYNCHRONOUS – See Bisync.

BIRTH-DEATH (BD) SYSTEMS– Those queuing systems where the change in state at any one moment is only a + 1, 0, or -1. Namely, a single customer is serviced and leaves the system; no customer leaves or joins the system; or a new customer joins the system. The M/M/c-type queues are BD systems.

BISYNC – A method or protocol originated by IBM that includes control characters and procedures for controlling the establishment of a valid connection and transfer of data. It is being replaced by SDLC. Also called Binary Synchronous and BSC.

BIT – A contraction of Binary Digit. It is the smallest unit of information in a binary system.

BITS PER SECOND (bps) – Rate at which bits are transmitted.

BLF – See "Busy-Lamp Field."

BLOCK – A group of characters of bytes transmitted as a unit.

BLOCKING – The inability to complete a call because all possible paths between the two calling stations are already in use.

BOC – See "Bell Operating Company."

BPS – See "Bits Per Second."

BREAK – An interruption to a transmission; usually a provision to allow a controlled terminal to interrupt the controlling computer.

BRIDGE – The connection of one circuit or component to another.

BRIDGE LIFTER – A device that removes, either electrically or physically, bridged telephone pairs.

BRIDGED RINGING – A system where ringers on a line are connected across that line.

BROADBAND – Referring or pertaining to an analog circuit that provides more bandwidth than a voice grade telephone line, i.e., a circuit that operates at a frequency of 20KHz or greater. Broadband channels are used for high-speed voice and data communications, radio and television broadcasting, some local area data networks, and many other services. Also called wide-band.

BROADCAST – 1) Delivery of a transmission to two or more stations at the same time such as over a bus-type local network or by satellite. 2) Protocol mechanism whereby group and universal addressing is supported.

BSC – See Bisync.

BTAM – Basic Telecommunications Access Method. IBM's lowest level I/O macro-routine support for implementing host computer communications programs.

BUFFER – A temporary or dynamic storage facility. It carries both logical (use within a program) and physical connotations.

BUSY HOUR – The 60-minute time span during the day with the maximum average traffic density.

BUSY-LAMP FIELD (BLF) – Visual indicator commonly used with key systems that displays internal lines in use.

BUSY SIGNAL – An audible or visual signal that indicates the called number or transmission path is unavailable.

BUSY VERIFICATION – A switching system service feature in the PSTN that permits an attendant to verify the busy or idle state of station lines and to break into the conversation.

BYPASS – Mechanism for providing communications service that bypasses the local telephone company. For example, a PBX connection to another similarly owned PBX, or from a PBX to a long-distance carrier by customer-owned wiring, optic carrier, or microwave.

BYTE – A computer-readable group of bits, normally 8, 16, or 32 bits in length.

CABLE – An assembly of one or more conductors or optical fibers within an enveloping sheath, constructed so as to permit use of the conductors singly or in groups.

CALL ACCOUNTING SYSTEM – Device that tracks outgoing calls and records data for reporting. Also called Station Message Detail Recording (SMDR).

CALL COLLISION – A condition arising when a trunk or channel is seized at both ends simultaneously, thereby blocking a call.

CALL DIVERSION – Automatic switching of a call from the number to which it was directed to another predetermined number.

CALL DURATION – Interval of time from the moment the connection is established to the instant the calling party terminates the call.

CALL FORWARDING – This feature allows a station user to program at any time any internal station number (or the attendant) and, when activated by the station user, all incoming calls to his station user, all incoming calls to his station will be automatically rerouted to that preprogrammed number.

CALL FORWARDING BUSY LINE – Automatically reroutes incoming calls directly to the attendant or predetermined secondary station when the called station is busy.

CALL FORWARDING DON'T ANSWER – Automatic rerouting to a secondary station or attendant when a given station does not answer within a prescribed time interval (the exact interval depends on the type of switching system, but it is generally about 30 seconds).

CALL HOLD – A feature that allows a station user to hold any call in progress on that station line by flashing the switchhook, dialing a second digit such as "1", or depressing a special station pushbutton that will automatically provide a second dial tone for the purpose of originating another call.

CALL HOUR (CH OR ch) – A unit of traffic density. One call hour is the quantity represented by one or more calls with an aggregate duration of 1 hour.

CALL MINUTE (Cmin) – A unit of traffic density (intensity). The quantity represented by one or more calls with an aggregate duration of 1 minute.

CALL PICKUP – Ability of a station user to answer any call directed to another station within a given pickup group by dialing a pickup code from either an idle or a busy state. If more than one call is waiting to be picked up in a group, the call to be answered is selected randomly.

CALL PROCESSING – Sequence of operations performed by a switching system from the acceptance of the incoming call to the termination.

CALL PROGRESS TONES – Audible signals returned to the station user by the switching equipment to indicate the status of a call; dial tones and busy signals are common examples.

CALL RECORD – All recorded data pertaining to a single call, usually including time of call, call length, destination, etc.

CALL RESTRICTION – A PBX feature that prevents selected extension stations from dialing toll calls.

CALL SECOND (Cs) – A unit of traffic density (intensity), where 1 Cs is the quantity represented by one or more calls with an aggregate duration of one-second.

CALL SPLITTING – Feature that allows an attendant to speak privately to either party in a connection without the other party hearing.

CALL TRANSFER – Feature that allows the calling or called customer to instruct the switching equipment or operator to transfer a call or calls to another system.

CALLED-LINE IDENTIFICATION FACILITY – A service feature provided by a network, which enables a calling terminal to be notified by the network of the address to which the call has been connected.

CALLING SIGNAL – A call control signal transmitted over a circuit to indicate that a connection is desired.

CAMP-ON – Mechanism that places a subscriber calling a busy number into a waiting position (queue).

CAMP-ON INDICATION – A special low-volume warning tone bursts on the existing busy connection to indicate to the parties that another call is waiting.

CAPACITANCE – The ratio of electrical charge between two conductors and their potential difference.

CAPACITY – The average amount of traffic that a circuit or circuit group can handle.

CARRIER (CXR) – 1) Continuous frequency capable of being modulated, or impressed, with a second (information carrying) signal. 2) Communications company or authority providing circuits to carry private traffic (also known as common carrier).

CARRIER STATION – Transmission system wherein two or more channels are derived from a single path.

CARTERFONE DECISION – A 1968 landmark FCC ruling that extended the 1956 Hush-A-Phone Decision to include the interconnection of all types of telephone equipment to the public-switched network. The decision allowed telephone subscribers to own and use telephone equipment providing it was not technically harmful to the network.

CATEGORY 1 – Connections to the circuits identified in Section 68.2 of the FCC's Rules and Regulations.

CATEGORY 2 – Connections not affected by Point 68 of the FCC's Rules and Regulations.

CCITT – Consultive Committee International Telegraph and Telephone; an advisory committee established under the United Nations to recommended worldwide standards.

CCS (100(c) CALL SECONDS) – A unit of traffic quantity equal to a 100-second call or an aggregate of 100-second calls.

CELLULAR MOBILE TELEPHONE SERVICE – A type of mobile telephone service in which the geographic serving area is divided up into subregions (or cells), each with its own antenna and switching node.

CENTRAL OFFICE (CO) – Local telephone company's centralized switching equipment and outside plant where calls are switched over the local network or onto a long-distance network.

CENTRAL-OFFICE CODE – Part of the national numbering plan, the CO code is the second three digits of a subscriber's telephone number, which identifies the local switching office.

CENTRALIZED ATTENDANT SERVICE (CAS) – The capability of a centrally located attendant console to control a number of switches, some of which may be geographically remote.

CENTRALIZED AUTOMATIC MESSAGE ACCOUNTING (CAMA) – Automatic message accounting system that is located at an exchange, but that serves various adjacent exchanges. Calls not processed by ANI must be routed through an operator who dials the calling number into the equipment.

CENTREX – A business switching service provided exclusively by local operating companies using monopoly, CO switching equipment and outside plant as an alternative to PBX service.

CENTREX CUSTOMER STATION REARRANGEMENT (CCSR) – Feature that allows Centrex users to make their own moves and changes. This feature requires the use of CPE.

CHANNEL – A path for electrical transmission between two or more points without common carrier-provided terminal equipment; also called a link, line, circuit, or facility.

CHARACTER – A unit of information, usually associated with people-language style of presenting information. Because so much data is handled and transferred in this style, the term is also frequently used to mean one bit pattern in a particular data code.

CICS – Customer Information Control System. IBM communications monitor software system with data base capabilities.

CIRCUIT – Physical connection of channels, conductors, and equipment required to provide a complete communications pathway.

CIRCUIT KEYS: LOCKING – Pushbutton keys are provided for station circuit selection which are mechanically interlinked to prevent two buttons from being depressed at the same time.

CIRCUIT SWITCHING – Physical interconnection between two circuits or channels. The term is in contrast with message switching.

CIRCUIT SWITCHED DIGITAL CAPACITY (CSDC) – A switched 56K bps service that allows alternate voice/data transmission.

CLASS 1 OFFICE – One of 12 regional centers in the United States and Canada.

CLASS 2 OFFICE – Sectional switching center.

CLASS 3 OFFICE – A Primary Center where local exchanges are connected and where long-distance calls are established.

CLASS 4 OFFICE – A Toll Center; the first stage of concentration for traffic originating at end offices.

CLASS 5 OFFICE – The end office where customers are connected.

CLASS OF SERVICE – Categorization of telephone subscribers according to specific type of telephone use. Telephone service distinctions include, for example, rate differences between individual and party lines, flat rate and message rate, and restricted and extended area service.

CLASS OF SERVICE INTERCEPT – If a particular station attempts to place a call which is not authorized by his Class of Service making, the station will be automatically rerouted to the attendant for challenge or further processing by the attendant.

CLOCK – A source of precisely spaced signals. It provides the basis for imposing time spacing on transmitted bit patterns and interpreting received bit patterns. It can be located in the business machine or in the modem.

CO – See "Central Office."

COCOT – See "Customer-owned Pay Telephone."

CODE CALL ACCESS – Allows attendants and station users to dial an access code and a two or three-digit called party code to activate signaling devices throughout a customer's premises with a coded signal corresponding to the called code (either audible or visual). The called or "paged" party can then be connected to the calling party by dialing a "Meet-Me" answering code from any station within the PBX system.

CODEC – A device that "codes" analog voice-signals into digital bit-streams for transmission over digital circuits (channels), and then "decodes" the bits into analog waves at the receiving end of the circuit.

COLLECT CALL – When an originating party requests that the receiving party accept responsibility for call payment.

COMBINATION TRUNK – A central office trunk circuit which is available as either an incoming or outgoing circuit to the attendant and also available through dial code access to internal stations users for outgoing calls.

COMMON BELL – The capability for an individual station ringer to respond to all incoming calls on all lines terminated on that instrument.

COMMON CARRIER – A government-regulated company responsible for the provision of telecommunications services in a given territory, providing users, at a cost, with access to communications.

COMMON CHANNEL INTEROFFICE SIGNALING (CCIS) – Signaling between central offices over a circuit separate from the communication (voice and message) channel.

COMMON CONTROL – A method of telephone switching in which the central logic system (or control equipment) is responsible for routing calls through the network. The control equipment is associated with a given call only during the period required for accomplishing the routing function.

COMMON CONTROL SWITCHING ARRANGEMENT (CCSA) – A private long-distance dialed network.

COMMON EQUIPMENT – Shared by all extensions in a multiline system, this equipment provides support functions or features (such as power, music on hold, CO connections).

COMMON TRUNK – In telephone systems having a grading arrangement, a trunk accessible to all groups of the grading.

COMMON USER CIRCUIT – A circuit designated to furnish a communications service to a number of users.

COMMUNICATION CENTER – A facility that serves as a node for a communications network(s). It is equipped for technical control and maintenance of the circuits originating, transmitting, or terminating at the node. It may or may not be provided with message center facilities and may or may not serve as a gateway between networks.

COMMUNICATIONS LINK – Facility that permits transmission between two or more points within a network.

COMPRESSION – The application of any of several techniques that reduce the number of bits required to represent information in data transmission or storage, therefore conserving bandwidth and/or memory.

COMPUTER MAIL SYSTEMS – E-mail systems which employ centralized "post offices" on host computers. Satellite computer terminals can access the post office to read, answer, forward, file, or delete waiting messages.

COMPUTER II – 1980 FCC ruling that established a framework for the transition to open and competitive CPE and enhanced transmission services markets. The Computer II decision ordered the provision of non-basic or "enhanced services" and CPE to be detariffed, and required the then-integrated Bell System to establish a fully separate subsidiary for the marketing of such services.

COMPUTER III – 1986 FCC ruling that removed the separate subsidiary requirement for both AT&T and BOC provision of enhanced services.

CONDITIONED LOOP – A loop that has conditioning equipment to obtain the desired line characteristics for voice or data transmission.

CONDITIONING – Alteration of electrical characteristics of a communications facility by adding components or selection among available paths to provide a path that has characteristics that fall within a standard range.

CONDUIT – Tubing through which telephone cables are passed.

CONFERENCE CALL – A call established with three or more stations in such a manner that each of the stations is able to carry on communications with the other.

CONFIGURATION – The hardware and software design governing the operation of a PBX telephone system.

CONNECTING ARRANGEMENT – See "Protective Coupler."

CONNECTIONS PER CIRCUIT HOUR (CCH) – A unit of traffic measurement; i.e., the number of connections established at a switching point per hour.

CONSOLE-LESS OPERATION – This feature allows internal stations to answer all incoming calls and processes then to the proper stations.

CONSULTATION HOLD – The incoming call is automatically placed on "hold" and the station user is given a PBX system dial tone. The station user proceeds to establish connection with another station. The original station can return to the incoming call.

CONSULTATION HOLD--ALL CALLS – Similar to the CONSULTATION HOLD facility but not restricted to incoming calls only.

CONTENTION – A condition arising when two or more data stations attempt to transmit at the same time using a shared channel.

CONTROL CHARACTER – A character inserted into a data stream for signaling the receiving station to perform a function or to identify the structure of the message. Newer protocols are getting away from character-oriented control procedures into bit-oriented control procedures.

CORD SWITCHBOARD – An operator position utilizing the traditional cords and jacks for establishing incoming call connections.

CORDLESS TELEPHONES – Portable handsets that can place and receive voice calls via two-way radio transmissions to the main telephone set base, which is wired to the public telephone network.

CORE MEMORY – Nonvolatile computer memory used to store the basic control programs in a PBX.

COUNTRY CODE – In direct distance dialing, a code characterizing a particular country. Codes corresponding to the world numbering plan start with a single digit that identifies a particular geographical area. This can be followed by one or two extra digits.

COUPLER – A name for an interconnecting unit.

CPE – See "Customer Premises Equipment."

CPS – Characters per second.

CRC – See cyclic redundancy check.

CROSS CONNECTION – The actual tying together of telephone equipment in the central office.

CROSS-OFFICE TRUNK – A trunk whose terminations are within a single facility.

CROSS-TALK – Energy leak from one channel to another. On the telephone network you hear somebody else's conversation.If transmitting data, a noise source.

CROSSBAR SWITCH – An electromechanical switch that employs specialized components to handle number entry and circuit completion separately.

CROSSREED SWITCH – A variation of cross-bar technology in which tiny electromechanical relays encased in vacuum tubes replace bulky mechanical relays.

CRT – Cathode ray tube. Used to display information visually.

CURRENT LOOP – Transmission technique that recognizes current flows, rather than voltage levels. It has traditionally been used in teletypewriter networks incorporating batteries as the transmission power source.

CURSOR – A visual indicator used in a display terminal to precisely identify the next entry position.

CUSTOMER – Any entity requiring some service dispensed by a server with limited resources (so that a queue would form). The customer could be a human being or some other entity such as a computer program, a telecommunications call, a packet, and so on.

CUSTOMER ACCESS LINE CHARGE (CALC) – Basic rates paid for lines from customer premises to central office.

CUSTOMER-OWNED PAY TELEPHONE – A pay telephone owned or rented by customers rather than by the local exchange telephone company.

CUSTOMER PREMISES EQUIPMENT – Any apparatus – including telephone handsets, PBX switching equipment, key and hybrid telephone systems, and add-on devices – that is physically located on a customer's property, as opposed to being housed in the telephone company's central office.

CUSTOMER RETRIALS – The number of times a telephone user will retry a call after finding a busy signal.

CYCLIC REDUNDANCY CHECK – A method for encoding the bits of a message into a group of usually 16-bits, which are appended to the message. All of the message bits are incorporated into the single checking group. The encoding procedure typically treats the message bit groups as a binary polynomial, divides it by a fixed polynomial, and uses the remainder as the check group.

DATA – A singular noun meaning information. (Originally the plural form of the Latin noun datum; if you transmit Latin, use data as a plural noun).

DATA CIRCUIT – A two-way means of transmitting data between two channels.

DATA CIRCUIT-TERMINATING EQUIPMENT (DCE) – A device that maintains and terminates a connection between the data terminal equipment (DTE) and a communications facility.

DATA LINE INTERFACE – Point where a data line is connected to a telephone line.

DATA-PHONE – An AT&T trademark. Originally referring to the transmission of data over the telephone network, it is now used by AT&T for any data transmission using its equipment and facilities.

DATA SET – Logical name for data file, used to eliminate reference to physical storage device. See also modem.

DATA TERMINAL EQUIPMENT (DTE) – A device which transmits and/or receives data to a data communications system (the data source).

DCA – Distributed Communications Architecture developed by Sperry Univac.

DDD – An abbreviation for Direct Distance Dialing, which means making long-distance telephone calls without operating assistance. DDD is normally used in data communications to mean the switched telephone network.

DDS – Data-Phone Digital Service. An AT&T service offering.

DECIBEL (dB) – Unit for measuring relative strength of a signal parameter such as power, voltage, etc.

DEDICATED ATTENDANT LINK – This facility assures the

availability of an intercom link for the attendant announcing incoming calls to the stations within the system.

DEDICATED LINE – A communications line provided to a single organization and used exclusively by that organization.

DELAY – In communications, the wait time between two events, such as from the moment when a signal is sent until it is received.

DELAY ANNOUNCEMENTS – Associated with ACD capability, provides a recorded announcement to incoming calls that are delayed and placed in queue. The user can vary the time interval between the first and second delay announcements.

DELAY DISTORTION – A way of measuring the change in a signal from the transmitting end to the receiving end, expressed in terms of the difference in time it takes for signals of different frequencies to pass. It accounts for the tendency of components in the circuit to store energy and release it at a later time.

DELTA MODULATION – Method of representing a speech waveform (or other analog signal) in digital form in which successive bits represent increments of the waveform. The increment size is not necessarily constant.

DEMAND ASSIGNMENT – Technique whereby various users share a communications channel on a realtime demand basis. Upon completion of the call, the circuit is deactivated and the capacity is available for others.

DEMODULATION – Process of retrieving data from a modulated carrier wave.

DEREGULATION – The reduction in tariff, market entry and exit, and facilities regulation of public telecommunications services in response to competitive and technological pressures in the telecom industry.

DIAL CALL PICKUP – A station user can dial a special code and thereby answer any incoming calls ringing on any other station within his own predefined "pick-up" group.

DIAL "O" TRUNKS TO ATTENDANT – Special single-digit dialing service by any station to the attendant console or cord switchboard.

DIAL PULSE – The current interruption in the DC loop of a calling phone. It is produced by the breaking and making of the dial pulse contacts of a calling phone when a digit is dialed.

DIAL SELECTION OF STATIONS – Indicates that the system accepts dialing of the number of the desired intercom station.

DIAL SPEED – Number of pulses that a rotating dial can transfer in a given amount of time.

DIALTONE – A signal heard when the telephone handset is offhook indicating that the central office is ready to accept and process a dialed number.

DIAL TONE SPEED (DTS) – The percentage of dial tone bids accomplished within a set number of seconds (usually three seconds).

DIAL THROUGH – A technique applicable to access circuits permitting an outgoing routine call to be dialed by the PBX user after the attendant has established the initial connection.

DIBIT – A pair of bits treated as one information element. In modulation schemes with more than two states, multiple bits are represented by each state. The term dibit originally was used for the AT&T 201 series of modems, which used four phase states to encode information; each state could therefore represent two bits.

DICTATION ACCESS AND CONTROL – Allows station users to have dial access to centralized dictating equipment and to maintain telephone dial control of all normal dictation system features.

DIGITAL – Referring to communications procedures, techniques, and equipment whereby information is encoded as either binary "1" or "0"; the representation of information in discrete binary form, discontinuous in time, as opposed to the analog representation of information in variable, but continuous, waveforms.

DIGITAL BIT-STREAM – A series of bits, or on/off signals.

DIGITAL CROSS CONNECT SYSTEM (DCS) – A computerized or manual facility which allows DS-1 lines to be remapped electronically at the DS-0 level. Also called a DACS or DXS.

DIGITAL SIGNAL – Transmission signal that carries information in a discontinuous stream of on/off

pulses.

DIGITAL SPEECH INTERPOLATION (DSI) – A technique for squeezing more voice conversations onto a trunk. DSI digitizes speech so it can be cut into slices such that no bits are transmitted when a speaker is silent. As soon as speech begins, bits flow again.

DIGITAL SWITCH – Switching equipment designed, designated, or used to perform switching of digital signals.

DIGITAL SWITCHING – A process in which connections are based on digital signals without converting them to analog signals.

DIGITAL TERMINATION SYSTEM (DTS) – A short-haul, digital microwave system which can provide full duplex transmission at speeds ranging from 1.2k bps to 1.544M bps. Users can transmit data, digitized voice, facsimile, and video over the systems.

DIGITAL-TO-ANALOG (D-A) CONVERTER – A device that converts a digital input signal to an analog output signal carrying equivalent information.

DIGITAL TRANSMISSION GROUP – A number of voice channels that are combined into a digital bit stream for transmission over various communications media.

DIGITIZE – To convert an analog signal to a digital signal.

DIRECT ATTENDANT SIGNALING LINES – The station user merely activates (momentarily) the pushbutton to signal the attendant, and when time permits, the attendant rings the station and verbally seeks instructions.

DIRECT CALL PICKUP – A station user is able to answer calls ringing on any other station within the PBX system by dialing the unique answer code of that station to be answered. If the call has already been answered by the called station, the station user who dials the answer code may be "added on" (in conference) to the connection.

DIRECT CURRENT SIGNALING – A method whereby the signaling circuit E&M leads use the same cable pair(s) as the voice circuit and no filter is needed to separate the signaling frequency from the voice transmission.

DIRECT DIALING SERVICE – A service feature that permits a user to place credit card calls, collect calls, and special billing calls information into the public telephone network without operator assistance.

DIRECT-IN LINES – Allows direct termination of separate central office lines to station instruments, by-passing the attendant console.

DIRECT INWARD DIALING (DID) – Method of connecting calls originating on the public switched telephone network directly to dial specified stations on a PBX system.

DIRECT OUTWARD DIALING (DOD) – Method of connecting stations on a PBX system to the public switched telephone network through the use of the station dial equipment only.

DIRECT SELECTION – A characteristic key telephone system feature that allows the user to manually select and access any of several CO lines.

DIRECT STATION-SELECTION (DSS) – Key system feature that provides the attendant with direct pushbutton signaling of all internal stations.

DIRECTIONALIZATION – The temporary conversion of a portion or all of a two-way trunk group to one-way trunks favoring traffic flowing away from a congested switch. Adjacent nodes must cooperate to accomplish this action.

DIRECTORY ASSISTANCE – A service provided by telephone companies to aid subscribers in obtaining unknown phone numbers.

DISCONNECT – The disassociation or release of a switched circuit between two stations.

DISCRIMINATING RINGING – Two different types of station ringing are provided to give audible indication of internal or external incoming calls.

DISTORTION – Unwanted change in waveform that occurs in between points in a transmission system.

DISTRIBUTED PROCESSING – A general term, usually referring to the use of intelligent or programmable terminals at sites remote from a company's main computer facility. The difficulty of associating a precise definition with the term stems from the source of the concept--i.e., the programmability of the terminal. Because such program-

mability can be used to provide component control, line control, data formatting, date validation, data manipulation and computation (processing), file creation, and file manipulation (also data processing, terminal programmability itself is insufficient to identify distributed processing. The trend is towards provision of some measure of local storage (e.g., diskette, cartridge disk, cassette, or cartridge tape) and capabilities for file manipulation as well as data validation and computation within the context of distributed processing remote workstations.

DIVESTITURE – Under the terms of the MFJ, AT&T relinquished ownership and control of the local Bell telephone operating companies.

DOCKET 19528 – FCC proceeding that in 1975 established the Registration Program allowing non-telco supplied CPE to be directly connected to the network without protective couplers.

DOCKET 20097 – 1976 FCC regulations permitting the unlimited resale and shared use of private-line facilities.

DOMESTIC SATELLITE (DOMSAT) DECISION – 1972 FCC ruling that expanded the 1971 Specialized Common Carrier Ruling by encouraging non-AT&T companies to provide satellite long-distance telecommunications services.

DON'T ANSWER RECALL – For either internal or outside calls, a station user who experiences a "don't answer" condition at the called station may have the call automatically retried at a later time by the use of a preassigned single or two-digit code.

DOUBLE CAMP-ON INDICATION – A station attempting to camp-on to another station which is already being "camped-on" shall receive a distinctive audible-signal and may be denied the ability to camp-on.

DOWNLINK – A link from a satellite to an earth station.

DOWNTIME – Total time a signal is out of service due to equipment failure.

DROP – A connection point for a terminal on a line.

DS-1 – Digital Signal 1, a digital transmission format in which 24 voice channels are multiplexed into one 1.544M bps (U.S.) or 2.108M bps (Europe) T1 digital channel.

DSDS – Data-Phone Switched Digital Service; a service offering of AT&T.

DSS – See "Direct Station-Selection."

DUAL TONE MULTIFREQUENCY (DTMF) – Method of signaling (dialing) using a tone pad. Each digit dialed generates a unique frequency which the central office is programmed to recognize as a particular digit.

DUPLEX – Simultaneous transmission in both directions; synonymous with full-duplex.

E-MAIL – See "Electronic Mail."

E&M SIGNALING – Transmission that uses separate paths for signaling and voice signals. The "M" (derived from "mouth") lead transmits ground or battery to the distant end of the circuit while the "E" (derived from "ear") lead accepts the signal.

EARTH STATION – Equipment on the ground that sends/receives signals to/from satellites.

EBCDIC – Extended Binary Coded Decimal Interchange Code. 8-bit code originated by IBM.

ECHO-- Signal distortion that occurs when a transmitted signal is reflected back to the originating station.

ECHOPLEX – An echo check applied to public switched network terminals operating in the two-way simultaneous mode.

ECHO SUPPRESSOR – Used to attenuate echoes on long-distance telephone connections. The unit, inserted at four-wire points, is voice actuated and functions by increasing loss into the transmission path opposite in direction to the one being used.

ELECTROMAGNETIC COMPATIBILITY (EMC) – The capability of telecommunications equipment, subsystems, or systems to operate in their intended operational environments without suffering or causing unacceptable degradation because of electromagnetic radiation or response.

ELECTROMAGNETIC INTERFERENCE (EMI) – Radiation leakage outside a transmission medium that results mainly from the use of high-frequency wave energy and signal modulation. – EMI can be reduced by ap-

propriate shielding.

ELECTROMECHANICAL KEY TELEPHONE SYSTEM – Key system that incorporates mechanical switches and relays rather than solid-state microprocessor chips.

ELECTRO-MECHANICAL RINGING – A "traditional" bell or buzzer is provided in the station instrument to give audible incoming call indication.

ELECTRONIC KEY TELEPHONE SYSTEM – Key system that incorporates solid-state microprocessor chips rather than mechanical switches and relays.

ELECTRONIC MAIL – Any communications service that permits the electronic transmission and storage of text messages.

ELECTRONIC SWITCHING – Switching technology based on the use of microprocessor chips and integrated circuits.

EMBEDDED BASE – All Bell-supplied equipment in-place on customer's premises as of January 1, 1983. This equipment was transferred from the Bell operating companies to AT&T at the time of divestiture.

EMERGENCY ACCESS – An emergency alarm system integrated into the PBX switching system may be implemented by uniquely ringing all station instruments to indicate an emergency condition.

EMERGENCY DIALING – Allows all system users the ability to use preassigned two or three digit numbers which translate to the "outside" central office numbers for local police, local fire, ambulance service, etc.

END OFFICE – A local exchange office where the user's loop terminates.

ENHANCED PRIVATE SWITCHED COMMUNICATIONS SERVICE (EPSCS) – AT&T Communications service providing a private interLATA electronic tandem tie-line network linking several of a customer's locations together.

ENHANCED SERVICE – The combination of "basic" service with computer processing applications that results in a modification of the transmitted information.

ENTERPRISE NUMBER – Another name for a toll-free number.

ENTRANCE TO NETWORK FACILITIES FOR INTERSTATE ACCESS (ENFIA) – Predivestiture rate system whereby other common carriers and large users reimbursed the Bell System for dedicated access to the line side or trunk side of a central office. ENFIA has since been replaced by "Feature Groups."

EQUAL ACCESS – Requirement that the BOCs give all long-distance telephone companies connections to the local loop that are equal in quality to those provided to AT&T Communications.

EQUALIZATION – Compensation for changes in signal attenuation.

ERGONOMICS – The science of determining proper relations between mechanical and computerized devices and personal comfort and convenience; e.g., how a telephone handset should be shaped.

ERLANG (E) – The internationally accepted (and best) dimensionless unit of traffic intensity. 1 E is the intensity of traffic in a resource (trunk, etc.) continuously occupied (i.e., carrying 1 call-hour per hour, 1 call-minute per minute, etc.).

ERROR – Any change from the original. In data communications; error usually means detected error. In any error detection scheme, there are some conditions that result in errors that are not detectable.

ERROR BURST – An occurrence that causes a large number of consecutive, transmitted bits to be affected. It is significant because it is common, and, while detectable, cannot be easily compensated for. Thus retransmission is the normal correction procedure.

ERROR CONTROL – More properly the subject of a text book than a definition, it means detecting and correcting errors.

EXCHANGE – A switching center, or the area where a common carrier furnishes service at the exchange rate and under the regulations applicable in that area as prescribed in the carrier's filed tariffs.

EXCHANGE AREA – A geographic area served by one or more central offices within which each telephone company furnishes local telephone service under regulation.

EXCLUSIVE HOLD – Only the station that has placed a line circuit on hold is capable of breaking the hold condition and reestablishing conversation.

EXECUNET DECISION – 1977 decision by the U.S. Circuit Court of Appeals that allowed non-AT&T long-distance companies to compete directly with AT&T for basic dial-up long-distance service.

EXECUTIVE BUSY OVERRIDE – Preselected stations are enabled, upon encountering busy signal on a call to an internal station, to dial a single digit and gain access to the existing conversation taking place.

EXHAUST – Date when a switching machine or any piece of telephone equipment is no longer sufficient in size to handle its work load.

EXPONENTIAL SERVICE DISTRIBUTION – Distribution of the service process where the PDF of the service time is (he-hx). This distribution is very common in queuing theory. In several communications problems, the service time is really the message length or the duration of a call. Exponential interevent time and Poisson number of events per unit time are equivalent characterizations of the same process.

EXPRESS ORDERWIRE – A permanently connected voice circuit between selected stations for technical control purposes.

EXTENDED AREA SERVICE (EAS) – This allows the subscriber to have a wider geographical coverage without extra per-call charges.

EXTENSION – A telephone set connected to a PBX or key system, or an additional set connected to a single residential or business line.

FACILITIES-BASED CARRIER – Interexchange carriers which own their network facilities and transmission lines.

FACILITY – Transmission path between two or more points, provided by a common carrier.

FACSIMILE – Technology that allows a paper message to be scanned optically, translated into digitally encoded pixels (patterns of tiny light and dark spots), and sent across the public telephone network to a receiving facsimile machine which reconstructs the original image.

FANCY PHONES – Proprietary telephones manufactured by individual PBX or key-system manufacturers to complement their telephone systems.

FCC – See "Federal Communications Commission."

FDM – Frequency division multiplexing.

FEATURE BUTTONS – Located on the telephone set, these buttons allow the user access to the system's features (e.g., "hold," do not disturb," "transfer," etc.)

FEDERAL COMMUNICATIONS COMMISSION (FCC) – An independent federal agency, authorized by the Communications Act of 1934, responsible for regulating interstate and foreign telecommunications.

FIBER-OPTIC SYSTEMS – Telephone transmission media using strands of clear glass fibers to carry hundreds of thousands of voice circuits. The signals are transmitted as light pulses.

FILTER – In telecom, equipment that permits the transmission of certain frequencies while excluding others.

FIRMWARE – Permanent or semi-permanent control coding at a micro-instruction level that implements a fixed application program, instruction set, I/O routine, operating routine, or other user-oriented function.

FIRST-IN/FIRST-OUT (FIRST-IN/FIRST-SERVED) – Queue management discipline where customers are admitted into service by their order of arrival. Other typical method are priority scheme, Last In/ First Out, and Random Order.

FIXED NIGHT SERVICE – Routes incoming central office calls, normally answered at the attendant position, to preselected stations within the PBX system when the attendant is not on duty.

FLASH – A signal generated by the momentary depression of the telephone switchhook or other device. The flash is used to request additional services.

FLAT RATE SERVICE – A fixed payment for service independent of use.

FLEXIBLE INTERCEPT – Allows completely flexible and instantly changeable intercept conditions to the attendant, such as unassigned number, temporary dis-

connect, etc.

FLEXIBLE LINE RINGING – Indicates the ability to arrange each station within the system with complete flexibility in regard to the ringing on incoming outside calls.

FLEXIBLE NIGHT SELECTION – Permits the attendant to "set up" night connections in accordance with day-to-day requirements.

FLEXIBLE RELEASE – The ability of the switching system to effect connection release either by the calling party or by the first party to hand up.

FLEXIBLE STATION NUMBERING PLANS – A system is capable of using station number assignments in a flexible manner.

FOOTPRINT – 1) Surface area within which the strength of a projected beam is above a certain level. Usually used in satellite communications to refer to the area where downlink signals above a minimum quality level can be received. 2) Amount of desk top space a piece of equipment (e.g., a terminal) requires.

FOREIGN EXCHANGE SERVICE (FX) 196 Connects user's location with a central office in a remote location, thereby providing user with local service in the remote exchange. Users in the remote location can also dial the FX number, which automatically rings in the primary location.

FORWARD BUSY – Feature wherein supervisory signals are forwarded in advance of address signals to seize assets of the system before attempting to establish a call.

FOUR-WIRE CHANNEL – Provision of two wire pairs (or logical equivalent) for simultaneous two-way transmission.

FOUR-WIRE CIRCUIT – Circuit with two pairs of conductors, one for outbound channels and the other for returning channels.

FRAME – Equipment in a common carrier office where physical cross connections are made between circuits.

FREQUENCY – The rate at which current alternates.

FREQUENCY-DIVISION MULTIPLEXING – A space-division multiplexing technique in which the available transmission frequency range of a given circuit is divided into narrower bands, each used to carry a separate conversation.

FREQUENCY MODULATION – Carrier transport technique that shifts the carrier frequency by an amount proportional to the value of the modulating signal.

FREQUENCY SHIFT – Modulation method that causes the frequency to vary at significant instants.

FSK – Frequency shift keying: common form of modulation using two separate frequencies to represent the two binary digits.

FULL-DUPLEX – A circuit or device that permits transmission in two directions at once.

FULLY RESTRICTED STATIONS – Denies selected station lines the ability to place or receive any but internal station-to-station calls.

FUNCTIONAL TEST – Test carried out under normal working conditions to verify that a circuit or a particular part of the equipment functions correctly.

FX – See "Foreign Exchange Service."

GAIN – An increase in signal power denoted in dBs.

GATE ASSIGNMENTS – Used in context of ACD equipment. Gates are made up of trunks that require similar agent processing. Individual agents can be reassigned from one gate to another gate by the customer via the supervisory control and display station. Also called splits.

GATE – A basic logic circuit.

GATEWAY – An important characteristic of a LAN that allows it to interface with different transmission networks, particularly the public-switched telephone network. The interface mechanism provides special data translation and conditioning functions for transmission compatibility between the networks.

GATEWAY CITY – A city where international calls must be routed. New York, Washington, DC, Miami, New Orleans, and San Francisco are the five gateway cities in the United States.

GRADE OF SERVICE – Measurement of the quality of phone service during the busiest hour of the day. A grade of p.01 would mean that one call in 100 would be blocked.

GRADE-OF-SERVICE INDEX, PBX – The probable percentage of blocked calls at a peak usage hour.

GROUND START – Telephony term describing a signaling method whereby one station detects that a circuit is grounded at the other end.

GROUP BUSY HOUR (GBH) – The busy hour offered to a given trunk group.

GROUP CALL – A special type of station hunting, requiring a special access number that will permit a call to the special access number and will ring the first available number in that group.

HALF-DUPLEX – A circuit or device capable of transmission in two directions, but not simultaneously.

HANDOFF – In a cellular radio system, the process of transferring a phone call in progress from one cell transmitter and frequency to another cell transmitter using a different frequency without interruption of service.

HANDS-FREE STATION – The capability of the station user to have "speakerphone" type operation on all calls.

HANDSET – The part of the telephone set that houses the speaker and microphone for talking and listening.

HANDSHAKING – The exchange of signals between two stations to provide control after a data connection is established.

HDLC – Bit oriented protocol being developed by ISO (International Standards Organization).

HEADSET – A voice communications sending and receiving device worn on the head and designed to leave the operator's hands free.

HERTZ (Hz) – Unit of frequency equal to one cycle per second.

HEXADECIMAL – A number system with 16 members represented by 0 through 9 and A through F. Used to easily identify the 16 possible bit patterns of a half-byte; two hex digits represent one byte.

HIGH-PASS FILTER – A filter which blocks all frequencies below a given limit and allows all signals above that limit to pass through.

HIGH-USAGE TRUNK – Allows direct trunks to bypass a part of the DDD switching network when high-volume traffic warrants.

HOLD – A telephone system feature that allows a call to be placed in abeyance for a temporary period without loss of connection.

HOLDING TIME – Length of time a communications circuit is in use for one completely processed transmission.

HOLLERITH CODE – Twelve level punched card code.

HOME LOOP – Operations using input and output units associated with a terminal when the terminal is connected to the line.

HOOKSWITCH – The cradle or button on which the telephone handset rests when not in use.

HOP – The excursion of a radio wave from the earth to the ionosphere and back to the earth.

HOT LINE SERVICE – A special connection between two stations where the second phone will automatically ring when the first phone is lifted off-hook.

HOT STANDBY – Alternate equipment ready to take over an operation immediately if the equipment presently in use fails.

HOWLER SIGNAL – Systems recognizing that a station is in "off-hook" condition for an excessive period of time and to "inject" the howler tone back to that station.

HUB – A communications center.

HUNT GROUP – A sequential series of telephone numbers that the central office tests when trying to complete a call to an establishment. The central office completes the call on the first idle number it finds.

HUNTING – Movement of a call as it progresses through a series of lines. Typically, if it cannot connect on the first line of the group it will move to the second, then the third, etc.

HUSH-A-PHONE DECISION – A 1956 U.S. Supreme Court ruling that allowed the attachment of non-AT&T manufactured equipment to an AT&T telephone as long as the public telephone network was not harmed.

HYBRID KEY TELEPHONE SYSTEM – Key telephone systems

that resemble PBX telephone systems in that they share line-access characteristics of both standard key and PBX systems.

IDENTIFIED OUTWARD DIALING – Key telephone systems that resemble PBX telephone systems in that they share line-access characteristics of both standard key and PBX systems.

IDLE – A phone that is not engaged or busy, thus available for use.

IMPULSE NOISE – Noise characterized by high amplitude, short pulses covering the entire width of the transmission path. It usually results from switching transitions or electrical storms.

IMS – Information Management System. IBM database management software system that also provides communications monitor functions.

INCOMING CALL IDENTIFICATION (ICI) – A switching system feature that allows an attendant to identify visually the type of service or trunk group associated with a call directed to the attendant's position.

INCOMING CALL INDICATOR – A lamp panel and associated audible signal provides alerting to personnel for incoming calls. This unit is usually placed at strategic locations within a customer's premises and is used with console-less systems.

INDEPENDENT TELEPHONE COMPANY – A company not fully or partly owned by AT&T. The term is now archaic since the BOCs became independent.

INDICATION OF CAMP-ON TO STATION – Short bursts of tone are periodically transmitted to the busy station to indicate to that station another call is waiting.

INDIVIDUAL TRANSFER ALL CALLS – This facility provides the capability of transferring any call by the station to another internal station. Features of CONSULTATION HOLD and ADD-ON CONFERENCE are usually included.

INFINITE-SERVER QUEUING SYSTEM – A system with infinitely many servers, as the M/M/oo; this is typical of self-service applications where the customer is serving himself/herself.

INTEGRATED CIRCUIT – A multifunction circuit formed in or around a semiconductor base.

INTEGRATED SERVICES DIGITAL NETWORK (ISDN) – The technical standards according to the all-digital local exchange will be designed. ISDN will provide a high-speed, high-bandwidth channel to every subscriber on the telephone network, achieving end-to-end digital functions with standard equipment interface devices.

INTEGRATED STATION – A terminal device in which a telephone and one or more other devices, such as a video display unit, keyboard, or printer, are integrated into one unit and utilized over a single circuit. The devices require one, two, or more pairs, depending upon system configuration.

INTEGRATED SYSTEM – A system that transfers analog and digital traffic over the same switched network.

INTEGRATED VOICE-DATA PBX – A PBX that can simultaneously switch both voice and data signals. Integrated voice-data PBX's are often characterized by their ability to support digital telephone station sets.

INTEGRATED VOICE-DATA TERMINAL (IVDT) – An instrument that includes a computer terminal keyboard/display and a telephone and may contain some processing power.

INTELLIGENT TERMINAL – One which includes a programmable processor and permits some level of processing (rather than just emulation alone).

INTELSAT – International Telecommunications Satellite Consortium, formed in 1964 with the goal of creating a world wide satellite system.

INTERACTIVE – "Question and answer" exchange between a user and a computer system.

INTERCEPT TREATMENT – A PBX feature that would stop an in-house call from going out to an unauthorized area code or exchange and redirect that call to an operator or a recording.

INTERCHANGE CARRIERS (IXCs) – Long-distance telephone companies that provide service between LATAs.

INTERCOM – Communication between two or more telephone sets within the same telephone system.

INTERCONNECT – Any company other than the local phone company that supplies equipment for connection to phone company lines by sale, lease, or rent.

INTERCONNECT FACILITY – One or more communications links used to provide local area communications service between or among several locations which, taken as a whole, form a node in the network.

INTERFACE – A bounded area between two pieces of equipment by which all signals that pass through are carefully defined.

INTERNATIONAL TELECOMMUNICATIONS UNION (ITU) – Agency of the United Nations established to ensure standard communications procedures and practices on a world wide basis.

INTEROFFICE TRUNK – Direct trunk between local central offices.

INTERPOSITION TRUNK – A connection between two positions of a large switchboard so that a line on one position can be connected to a line on another position.

INTERSTATE – Between two or more states.

INTRASTATE – Within one state.

INWARD RESTRICTION – Prevents selected station lines from receiving incoming central office calls.

INWARD WIDE AREA TELEPHONE SERVICE (INWATS) – A service where a subscriber pays a predetermined amount for all incoming toll calls, thus relieving the calling party of all payment responsibilities. This number is usually in the form of an 800 number.

ISDN – See "Integrated Services Digital Network"

IVDT – See "Integrated Voice-Data Terminal."

IXCs – See "Interexchange Carriers."

JUMPER – Patch cable or wire used to establish a circuit, often temporarily, for testing or diagnostics.

JUNCTOR – An intraoffice trunk set up as a connection between points in a switching system.

KEY ILLUMINATION: INCANDESCENT LAMP BEHIND KEY – Circuit status lamp indication behind circuit pushbutton with flashing incoming, steady busy and "wink" hold visual indications.

KEY SERVICE UNIT (KSU) – Box (or cabinet) housing the electric or electronic circuit boards that provide all features included in a key system. It also contains the power transformers and backup batteries that supply proper voltage to various system components.

KEY SYSTEM FEATURES – The central PBX switching equipment contains all necessary standard circuitry and control elements for standard Key Telephone station instruments being served by the PBX system.

KEY TELEPHONE SYSTEM – A multiline telephone system designed to provide shared access to several outside lines through buttons, or keys, on the handset, typically offering identified access lines with direct line appearances or terminations on a given station set.

KEYS – Buttons located on the key telephone set that are used to manually select or access a shared group of CO lines.

KINGSBURY COMMITMENT – A 1913 negotiation between the U.S. Department of Justice and AT&T, which required AT&T divest its Western Union holdings, halt the acquisition of independent telephone companies, and allow the interconnection of all lines owned by non-Bell-owned telephone operating companies to AT&T's long-distance network.

KSR – Keyboard Send and Receive. Keyboard and printer.

KSU – See "Key Service Unit."

LAN – See "Local Area Network."

LATAs – See "Local Access and Transport Areas."

LEAST-COST ROUTING – Transmission of long-distance calls over the least expensive carrier's line for a particular time of day and destination.

LINE – A transmission wire within a telephone system; part of a local loop that connects a subscriber to the central office.

LINE CARDS – Integrated circuit boards that provide physical termination points for telephone system lines, as well as providing features.

LINE HIT – In practical term a disturbance causing a detectable error on a communications line.

LINE HOLD RECALL – When a station places a line on "hold" and goes "on hook", the held line will automatically visually and audibly revert to incoming call condition.

LINE LOADING – The use of electrical components to change the "natural" response characteristics of a communications lines, with the idea of improving the situation.

LOCAL ACCESS AND TRANSPORT AREAS (LATAs) – Local telephone network areas controlled and operated by the BOCs.

LOCAL AREA NETWORK (LAN) – A high-speed data communications system with all aspects of the transmission medium controlled by a network operator. LANs typically permit the user to connect several diverse telecommunications and office equipment functions into a integrated system.

LOCAL EXCHANGE AREA – That part of the national telephone network controlled by the local telephone operating company and separate from the long-distance network. Local exchange areas are generally regulated by the state public utility commission.

LOCAL LOOP – Telephone wires and other facilities that link local subscribers to the local telco's central office.

LOCKOUT – Denies the attendant the ability to recenter an incoming central office connection directly terminated or held on her position, unless specifically recalled by the station user.

LONGITUDINAL REDUNDANCY CHECK – A method of error detection that collects and clocks parity for each code level. Traditionally, magnetic tape recording is done in a number of tracks equivalent to the number of bits per character; LRC then collects parity for each track. Parity is a two-level (odd/even) information element.

LOOP – A pair of wires from a central office to the subscriber's telephone.

LOOP CURRENT 96 The current from a battery at a central switch formed by closure of the phone hook switch. It is the presence or absence of the current that enables the automatic equipment in the central office to observe the set's operating status.

LOOP START – Most commonly used method of signaling an off-hook condition between an analog phone set and a switch, where picking up the receiver closes a wire loop, allowing DC current to flow, which is detected by a PBX or local exchange and interpreted as a request for service.

LOST CALL – A call that has not been completed for any reason other than cases where the called party is busy.

LRC – See longitudinal redundancy check.

MAIN STATION – The device (telephone set) that the user employs to answer incoming calls and to send out calls. It is connected to a local loop.

MAIN DISTRIBUTION FRAME (MDF) – Physical facility to which outside lines and trunks are terminated for protection and cross connected by jumpers to central office equipment.

MAINTENANCE – The necessary upkeep and repairs needed to maintain a level of quality for the service.

MANUAL CONSOLE ONLY – Refers to PBX systems which are not automatic and require all calls to be connected through the attendant position, including station-to-station calls.

MANUAL HOLD – the method of placing a line circuit on "hold" by activating a non-locking common hold button.

MARK – The signal (communications channel state) corresponding to a binary one. The marking condition exists when current flows (current-loop channel) or when the voltage is more negative than -3 volts (EIA RS-232-C channel).

MARKER – The common control device for a crossbar switch.

MARKOVIAN MODEL – Those systems in which future behavior depends only on the present and not the past. Birth-death systems are a special case of Markovian models.

MASTER NUMBERING HUNTING – A master number is assigned as the first number in the "hunt group", rather than the traditional utilization of the number of the first station within the "hunting group."

MASTER STATION – The station that has control over all stations in a multipoint circuit; used for polling or selection.

MATRIX – In switch technology, that portion of the switch architecture where input leads and output leads meet, any pair of which may be connected to establish a through circuit. Also called switching matrix.

MCI DECISION – 1969 FCC decision that licensed MCI to construct and operate an interstate radio link between St. Louis and Chicago and lease private-line services to business users. The MCI Decision marked the beginning of competition in the long-distance market.

MDF – See "Main Distribution Frame."

MEAN TIME BETWEEN FAILURES (MTBF) – Average computed length of time that a system will work without failure.

MEAN TIME TO REPAIR (MTTR) – The average time needed for a vendor to repair a system if it does fail.

MEASURED RATE – Message rate structure in which the rental includes payment for a specified number of calls within a defined area, plus a charge for additional calls.

MEDIA – The paths along which the signal is propagated, such as wire pair, coaxial cable, waveguide, optical fiber, or radio path.

MEET-ME CONFERENCE – This conference circuit is given a single-digit access code and any stations dialing that code at a predetermined time (or upon direction by the attendant or a secretary) are connected in conference.

MEMORY – In communications and computer technology, a device (usually integrated circuit chips) that retains information.

MESSAGE – A loose term identifying a complete transmission. It is sometimes used synonymously with block, and sometimes to mean a group of blocks representing one transmission period. Control information at the beginning is usually referred to as a header; the data portion, the text.

MESSAGE FORMAT – The procedure for placing specific portions of a message such as heading, address, end of message code, etc.

MESSAGE RELAY – Allows a PBX extension user to record and store a message for transmission to a given extension by a given time, after which it is relayed to the attendant.

MESSAGE SWITCHING – A computer based switching technique that transfers messages between points not physically connected. The switching facility receives messages, stores them in queues for each destination point, and retransmits them when a facility becomes available. It trades delivery time for lower cost when compared to direct interconnection of all points.

MESSAGE UNIT (MU) – The measurement used for charging local calls.

MFJ – See "Modified Final Judgment."

MICROWAVE RADIO – A radio frequency used extensively for long-distance telephone transmission. Digitally encoded messages are sent through microwave channels either between terrestrial antennae, via satellite, or through waveguides.

MINIMIZE – A condition wherein normal message and telephone traffic is drastically reduced so that messages connected with an actual or simulated emergency shall not be delayed.

MIXED STATION DIALING – Indicates the availability in the switching system to accommodate both rotary dial stations and Touchtone stations.

MOBILE TELEPHONE SERVICE – Transmission over the public-switched network of a voice signal that originates and/or terminates at a mobile site. The process involves radio signals transmitted to a centrally located antenna attached to a mobile-telephone switch. (See also "Cellular Mobile Telephone Service.")

MODEM – Device that "modulates" discontinuous digital signals into continuous analog waves for transmission over analog circuits, and then "demodulates" the waves into digital bit-streams at the receiving end of the circuit.

MODIFIED FINAL JUDGMENT (MFJ) – 1982 agreement between the Department of Justice and AT&T which called for the divestiture of the local Bell telephone operating companies by AT&T.

MODULATION – Impressment of information on a carrier signal by varying one or more of the signal's basic characteristics: frequency, amplitude, and phase. Differential modulation carries the information as the change from the immediately preceding state rather than the absolute state.

MU – In queuing systems, the average number of customers served per second. It represents the mean of the service distribution.

MULTIDROP – Configuration or topology designed to transmit data between a central site and a number of remote terminals on the same circuit. Individual terminals may be able to transmit to the central site but not to each other.

MULTIPLE ACCESS – The connection of a user or subscriber to two or more switching centers by separate access lines using a single message routing indicator or telephone number.

MULTIPLE TRUNK GROUPS – Indicates that the switching system is capable of being equipped for more than one group of trunk circuits.

MULTIPLEXER OR MULITPLEXOR – A device that combines several communication channels into a single circuit.

MULTIPOINT – Three or more stations connected to the same facility. It implies that the facility physically goes from one station to another until all are connected.

MULTIQUEUE MULTISERVER QUEUING SYSTEM – A queuing situation where customers form several lines and the server mechanism is composed of several entities. The M/M/c model is an example.

MUSIC ON CAMP-ON – Capability of the system to accommodate an audio source input for use with the attendant camp-on facility.

MUSIC ON HOLD SYSTEM – Availability of audio source input for systemwide distribution to all "held call" conditions within the system, both for attendant and station use.

NAK or NACK – A negative acknowledgement that indicates a block of data was received incorrectly.

NARROWBAND – A channel with a bandwidth of less than one voice grade level.

NATIONAL NUMBERING PLAN – A system that identifies every main (non-extension) telephone with a unique number for signaling purposes. The plan has three components: the area code, CO code, and a subscriber number.

NEGATIVE ACKNOWLEDGMENT (NAK) – Reply by the receiving party to the calling station that the previous data message was improperly received or was unintelligible.

NETWORK – 1) Series of points connected by communications channels. 2) Switched telephone network is the network of telephone lines normally used for dialed telephone calls. 3) Private network is a network of communications channels confined to the use of one customer.

NETWORK BUSY HOUR (NBH) – The busy hour for an entire network.

NIGHT ANSWER AND SIGNALING – Allows any station to access incoming outside calls on circuits not directly terminated on that particular station and to transfer that incoming call to any other station within the system.

NIGHT SERVICE AUTOMATIC SWITCHING – Should the attendant neglect to place the console in the night answering mode, after a certain period of timed ringing from an incoming central office call, the entire system will automatically engage into the night service mode.

NODE – A termination point for two or more communications links. The node can serve as the control location for forwarding (switching if you prefer) data among the elements of a network or multiple networks when networking. Node functions need not be restricted to data switching.

NOISE – Introduction of unplanned energy into a communications path, which can change the information signal.

NOISE SUPPRESSION – A receiver circuit arrangement that automatically reduces the noise output during periods when no carrier is being received.

NONBLOCKING SWITCH – A switch designed in such a manner with enough paths across it that an originated call can al-

ways reach an idle line without encountering a busy condition.

NON-CONSECUTIVE HUNTING – Non-consecutive Station numbers can be "searched" by the switching equipment upon dialing the initial number in the hunting group to find connection to the first non-busy station.

NORTH AMERICAN TELECOMMUNICATIONS ASSOCIATION (NATA) – Founded in 1970 by Tom Carter (Carterfone Decision), NATA provides a unified voice among telephone equipment manufacturers and vendors seeking to promoted industry-wide competition. Originally called the North American Telephone Association, the organization was renamed in 1982.

NUMBERING PLAN AREA (NPA) – Geographic subdivision of the territory covered by a national or integrated numbering plan. An NPA is identified by a distinctive area code (NPA code).

NXX – Code that designates a specific central office. "N" is any number from 2 to 9. "X" is any number from 0 to 9.

OCTAL – A number system with 8-bit patterns represented by the symbols 0 through 7. Two octal digits conveniently represent one six-bit character, the standard for data representation prior to the 8-bit byte, which is more conveniently represented by hexadecimal notation (a.v.).

OFF HOOK – Condition when the handset is lifted from the telephones's body signaling that the set is in use.

OFF-LINE – Equipment not directly connected to the central system. For example, card punches.

OFF-PREMISES EXTENSION (OPX) – Telephone extension located at a distance from the main switch.

ON HOOK – Condition when the handset is on the telephone cradle signaling that it is not in use.

ON-LINE – Equipment that is directly connected with the central system usually in an interactive relationship with the system's components.

ONE-WAY SPLITTING – When the attendant is in connection with an outside trunk and an internal station, activation of a key allows the attendant to speak privately with the internal station.

OPEN CIRCUIT – A circuit available for use.

OPEN SYSTEMS INTERCONNECTION (OSI) – A logical structure for network operations standardized within the ISO; a seven-layer network architecture being used for the definition of network protocol standards to enable any OSI-compatible computer or device to communicate with any other OSI-compatible computer or device.

OPERATING TIME – Total amount of time it takes a caller to dial a number, wait for the other end to answer, and then transmit the message. Also known as the call set up time.

OPERATOR – Person who assists in placing telephone calls.

OPTICAL FIBERS – See "Fiber-Optic Systems."

ORDERWIRE CIRCUIT – A voice or data circuit used by technical control and maintenance personnel for coordination and control action relative to activation, deactivation, change, rerouting, reporting, and maintenance or communications systems and services.

ORIGINAL EQUIPMENT MANUFACTURER (OEM) – Maker of equipment that is marketed by another vendor, usually under the name of the reseller. The OEM may only manufacture certain components, or complete computers, which are then often configured with software, and/or other hardware, by the reseller.

OTHER COMMON CARRIER (OCC) – Specialized common carriers (SCCs), domestic and international record carriers, and domestic satellite carriers that provide communications functions. The term distinguishes the OCCs from AT&T and the independent telephone carriers.

OUT OF BAND SIGNALING – The transmission of signaling via a different channel (either FDM or TDM) than is used for the primary information transfer.

OUTAGE – A telecom service condition wherein a user is completely deprived of service due to any cause within the communications system.

OUTAGE DURATION – That period of time between the

onset of an outage and the restoration of service.

OUTGOING LINE RESTRICTION – The ability of the system to selectively restrict any outside line to an "incoming only" line.

OUTGOING STATION RESTRICTION – The ability of the system to restrict any given station from originating calls on outside lines.

OUTGOING TRUNK CAMP-ON – Applying to any trunk group within the system, it allows the station user, upon encountering busy signal from that trunk group, to effect a camp-on to the trunk group (or individual trunk circuit) by dialing the appropriate code for this service. The station user then waits until that trunk circuit becomes free.

OUTPULSING – The process of transmitting digital address information over a trunk from one switching center or switchboard to another.

OUTSIDE PLANT – That portion of intrabase communications systems extending from the main distribution frame outward to the telephone instrument or the terminal connections for other technical components.

OVERFLOW – The excess traffic that is diverted to an alternate route.

OVERRIDE – Operation that allows certain stations to break into a line already in the busy condition.

OVERTIME PERIOD – 1)Conversation time on a charged call which is greater than the initial period (generally the time after the first minute). 2) Describing the occupancy time of WATS circuits in excess of the time contracted for in each period.

PABX – Private Automatic Branch Exchange, now used interchangeably with PBX.

PACKET SWITCHING – Data transmission technique in which data messages are divided into blocks, or packets, of standard length, each of which has address and control information coded into it.

PAD CHARACTER – A character inserted as fill when insufficient data characters are present to satisfy a length requirement.

PAGING BY ZONE – By dialing the appropriate access code, any station is able to selectively page "groups" of predesignated stations.

PAGING SPEAKERS – The inclusion of such speakers within the station instrument.

PAGING TOTAL SYSTEM – Upon dialing the appropriate special code, any station may originate a paging announcement through all loudspeakers.

PAM – See "Pulse-Amplitude Modulation."

PARALLEL TRANSMISSION – Simultaneous transmission of signals over separate channels of the same circuit.

PARITY – Constant state or equal value. For example, character bit patterns are forced into parity (total number of one bits odd or even) by adding a one or zero bit as appropriate. Parity checking is one of the oldest checking techniques. For high speed transmission, it has largely been supplanted by cyclic redundancy checking, which does not use as many checking bits.

PART 68 – The FCC rules regulating the direct connection of non-telephone company-provided equipment to the public telephone network.

PARTY LINE – A line where several subscribers' stations are connected with discriminatory signaling, possibly for selective calling.

PATCH – To connect circuits together temporarily by means of a cord (cable) known as a patch cord.

PATH ATTENUATION – The losses undergone by a wave in transit between a transmitter and a receiver, usually measured in decibels.

PAY TELEPHONE – Single-line telephone that can collect payment per dialed call.

PBX – See "Private Branch Exchange."

PCM – See "Pulse-Code Modulation."

PDF (PROBABILITY DENSITY FUNCTION) – The mathematical formulation of a continuous distribution, which provides a description of the probability that any event x in the sample space will actually occur.

PEG COUNT – Number of calls made or received in a specific time period.

PERCENT BREAK – The ratio of the open circuit time to the sum of the open and closed circuit times allotted to a single dial pulse cycle, expressed as a percentage.

PERMANENT SIGNAL (PS) – An extended off-hook condition not followed by dialing.

PERSON-TO-PERSON CALL – An operator-assisted call where the calling party specifies the person on the receiving end who must accept the call.

PHASE MODULATION – Transmission technique where the phase angle of the carrier is varied by the value of the signal to be transmitted.

PHASE JITTER – Random distortion of signal lengths; interferes with extraction of information by upsetting the timing.

PILOT TONE – Test frequency of controlled amplitude transmitted over carrier system for monitoring and control purposes.

PLAIN OLD TELEPHONE SERVICE (POTS) – The basic suppliance of a single telephone set with access to the public switched network.

PLANT – A general term for all equipment used by a telephone company in providing telecommunications services, usually divided into outside and inside plant.

POINT OF DEMARCATION – The point where the responsibility for wire installation and maintenance no longer belongs to the local telco, but to the user.

POINT OF INTERFACE (POI) – The physical telecommunications interface between the LATA access and inter-LATA functions. This point establishes the technical interface, the test points, and the points of operational responsibility.

POINT-TO-POINT – Describing a circuit that connects two points directly, where there are generally no intermediate processing nodes or computers, although there could be switching facilities. A type of connection, such as a phone line circuit, that links two, and only two, logical entities.

POINT OF PRESENCE (POP) – A physical layer within a LATA at which an interLATA carrier establishes itself for the purpose of obtaining LATA access and to which the local exchange company provides access services.

POISSON – Tables based on mathematical probabilities that can be used to calculate the number of circuits needed to provide a specified grade of service.

POISSON ARRIVAL PROCESS – One of the most commonly used distributions for the arrival of customers (calls, packets, etc.) to a telecommunications queue, named after the French mathematician who invented it. It describes the probability that a number of customers will arrive in a unit of time, and corresponds to an exponential distribution for the interarrival time. Used in such models as M/M/1, M/M/c/c, M/G/1, and so on.

POLAR KEYING – Form of current loop when current flow direction establishes the two-level binary signaling.

POLLING – A control technique where the central controller can distribute incoming calls by rating them higher or lower priorities.

POOLED ACCESS – A distinguishing characteristic of PBX telephone systems that allows the switch, when routing an external call, to seize an idle trunk from among a group of available CO lines.

PORT – An entrance to or exit from a network.

POWER FAILURE TRANSFER – Provides automatic transfer of central office lines to predetermined stations during a power failure when reserve power is not provided with the PBX system.

PREEMPTION – The seizure, usually automatic, of system facilities that are being used to serve a lower precedence call in order to immediately serve a higher precedence call.

PREMISES WIRING – Wiring that connects separately housed equipment entities or system components to one another, or wiring that connects an equipment entity or system component with a telephone network interface, located at the customer's premises and not within an equipment housing. Premises wiring consists of non-system and system wiring.

PRESET CALL FORWARDING – Incoming calls will be rerouted to a predetermined secondary number.

PRESUBSCRIBE – A telephone customer's subscription to a long-distance carrier, to which all long-distance calls will be automatically routed unless the subscriber uses the 10xxx dialing scheme to access an alternate carrier.

PRIMARY RATE INTERFACE (23B + D) – A level of service planned for ISDNs. In the U.S., consists of 23 B channels and 1 D channel; in Europe, this will be modified to a 30B + D format compatible with the CEPT trunks used there.

PRIVATE BRANCH EXCHANGE (PBX) – A private telephone switching system located on a customer's premises. Both PBX and hybrid PBX systems provide pooled access to a group of access lines typically by dialing "9" from an internal station set.

PRIVATE LINE – A long-distance circuit removed from the regular switched network and dedicated 100 percent for a specific customer's use.

PRIVACY OVERRIDE – Activation of a special pushbutton allows the station user to gain access to a given busy line, even though the AUTOMATIC EXCLUSION facility is engaged by the station using that line.

PRIVACY RELEASE – A station user who is using a specific circuit can release the facility, thereby allowing any other station which has an appearance of that line to gain conversation access to that line.

PRIVATE EXCHANGE (PX) – An exchange that only serves a particular user with no access to the public network.

PRIVATE NETWORK – A network of private lines used by customers that have offices in several different locations.

PROBABILITY OF N-CUSTOMERS IN THE SYSTEM – The probability that (at steady state) one will find n customers (calls, packets, etc.) waiting to go through the queue. Denoted by P_n. This is a crucial piece of information that must be quantified by the researcher trying to solve a model; all other measures of queue performance depend on it.

PROGRESSIVE, DIRECT CONTROL – The technological principle behind the step-by-step switch. A call is established and routed in progressive electromechanical steps, each controlled directly by the electrical pulses issuing from the user's dial.

PROPAGATION DELAY – The time required for a signal to travel from one point to another.

PROPRIETARY PHONE – See "fancy phones."

PRORATION – The distribution or allocation of equipment or components proportionally among a number of functions in order to provide a requisite grade of service.

PROTECTIVE COUPLER – A device leased from the telephone company as an interface between customer-provided equipment and the public telephone network. The couplers were required by telephone companies during the period between the Carterfone decision and the establishment of the FCC's Registration Program. The monthly lease charges for the couplers effectively constituted an economic barrier to customer's providing their own equipment.

PROTECTOR – A device used to protect telecommunications facilities and equipment from abnormal high voltage or current.

PROTOCOL – The rules of order by which a communications network is operated. Also the rules by which a specific data communications function must proceed.

PTT – Postal, telegraph, and telephone organization. Usually the governmental office that runs a foreign nation's communications system.

PUBLIC SWITCHED TELEPHONE NETWORK (PSTN) – The domestic telecommunications network commonly accessed by ordinary telephones, key telephone systems, PBX trunks, and data arrangements.

PUBLIC UTILITY COMMISSION (PUC) – State regulatory administrative body that directs intrastate utilities, including telecommunications. May also be known as a Public Service Commission (PSC) or some other label.

PUC – Public Utilities Commission.

PULSE – A signal that can be wholly described by a constant amplitude and the duration time. This signal form is typically used internally in computers, terminals, and other business

machines, but is also used by some communications facilities.

PULSE-AMPLITUDE MODULATION (PAM) – Technique in which an analog speech signal is sampled at specific short intervals, and a numerical value representing the magnitude of the wave's amplitude at that point is assigned to each sample. The first step in pulse-coded modulation.

PULSE-CODE MODULATION (PCM) – The most frequently used method of converting analog signals into digital bits. The process involves transforming an analog wave into quantified steps, assigning the steps a discrete set of values, and coding these values into a digital bit-stream. At the receiving end, the digital codes are transformed back into analog values and the original signal is reconstructed.

PUSH-TO-TALK OPERATION – Method of communication over a speech circuit in which transmission occurs from only one station at a time, the talker being required to keep a switch operated while talking.

PUSHBUTTON DIALING – A telephone set that uses buttons instead of a rotary dial to establish a circuit connection to a terminal point in the network.

QTAM – Queued Telecommunications Access Method. An older IBM communications I/O control routine, which has been largely replaced by QTCAM.

QUALITY OF SERVICE – See "grade of service."

QUEUE DISCIPLINE – The method employed by the server mechanism in picking customers from the queue. The common method is FIFO (first in first out), but others are available, including customer selection based on a priority scheme.

QUEUING – 1) In telephony, a feature that allows calls to be "held" or delayed at the origination switch while waiting for a trunk to become available. 2) Sequencing of batch data sessions.

RACK – The physical structure used for mounting communications apparatus. Also called a "bay" or equipment cabinet.

RADIO COMMUNICATION – Telecommunications by means of radio waves.

RAIN BARREL EFFECT – Telephone line distortion caused by the underattenuated echoes on the return path.

RATE – The price charged for telecommunication service or equipment.

RATE AVERAGING – The process telephone companies take to establish toll costs for long-distance calls.

RATE CENTER – The specific geographic location a telephone company uses to determine interexchange mileage for rate evaluation.

RATIO, SIGNAL-TO-NOISE – Ratio of the information conveying signal to the power of the noise on the line.

REAL TIME – Processing now, without delay. It is used by engineers to indicate processing in time to control an event, and by data processing personnel to indicate processing transactions as they occur.

RECEIVER – A device on the transmission line that converts a signal to whatever type of signal is needed to complete the transmission.

RECORDED ANNOUNCEMENT SERVICE – A special type of access trunk which when dialed, will connect the caller to a prerecorded message.

REDUNDANCY – Ancillary information, not directly essential though pertinent to a set of information. Also, the state of providing redundant or backup components to ensure uninterrupted operation of a system in case of failure, also called "failsafe" or "nonstop."

REGENERATOR – A piece of equipment that reshapes and amplifies distorted signals to their original form, usually digital.

REDUNDANCY CHECK – Automatic or instructed check used to determine the necessity of a function to a system.

REGIONAL CENTER – A class one exchange office. Every regional center in the United States connects sectional offices to each other.

REGIONAL HOLDING COMPANY (RHC) – One of seven firms created from the AT&T divesture, each of which acts as a holding company within a region of the United States for one or more of the 22 divested Bell operating companies, as

well as for their unregulated subsidiaries.

REGISTER – The device in an automatic office that receives information and stores it for possible conversion or translation.

REGISTRATION PROGRAM – AN FCC program that permits the direct connection of terminal equipment, whether customer-provided or telco-provided, to the public telephone network without the need for protective connecting arrangements. The technical standards for direct connection are contained in Part 68 of the FCC's Rules and Regulations.

RELAY – An electrical device that changes the flow of a current in an electrical circuit.

REMOTE ACCESS – A PBX feature that allows a user to operate a phone set at a location other than where the PBX is located.

REMOTE CALL FORWARDING – Forward calls to a distant exchange, but allows the calling party to call as if it were a local call.

REMOTE STATION LAMP FIELD – For use by stations, usually manned by secretarial personnel, who will frequently be answering several stations lines.

REORDER TONE – A unique tone received by the calling station when switching paths, trunks, or other communications equipment or facilities (except the called terminal) are not available for use during a call attempt.

REPEATER – Apparatus that automatically retransmits signals on an outbound circuit.

REPERTORY DIALER – A telephone set that stores a group of numbers frequently called by a customer and transmits the dialing information to the central office by a single action.

REQUEST FOR INFORMATION (RFI) – General notification of an intended purchase of communications or computer equipment, sent to potential suppliers to determine interest and solicit product materials.

REQUEST FOR PROPOSAL (RFP) – Follow-up to RFI, sent to interested vendors to solicit a configuration proposal, with prices, that meets a user's requirements.

RESALE CARRIERS – Interexchange carriers that lease transmission facilities and resell them to the general public.

RESALE SERVICE – The right of a buyer of basic telecommunications services, such as private lines, FX, or WATS, to resell and/or share with others the unused capacity.

RESPONSE TIME – Time period between terminal inquiry and computer response. It is one of the most frequently used measures of the performance of an inquiry/response or interactive system. Frequently, unrealistic demands for short response times lead to very expensive systems. On the other hand, poor systems development is often passed off with comments about unrealistic demands. Response time requires careful evaluation to place it in proper perspective.

RETURN LOSS – The measurement of the difference in the transmitted message received at the end of the transmission.

REVERSE-BATTERY SIGNALING – A loop signal where the battery and ground are reversed on the tip and ring of the loop to give an off-hook signal when the called party answers.

REVERSE CHANNEL – Provision of a simultaneous data path in the reverse direction over a half-duplex facility; normally it has a much lower bandwidth (transmission speed) than the main data path. Most commonly, it is used for positive/negative acknowledgements of previously received data blocks.

REVERSE CHARGE CALL – Call in which the caller specifies that the charge should be paid by the called party. Also called collect call.

REVERTIVE PULSING – In telephone networks, a means of controlling distant switching selections by pulsing, in which the near end receives signals from the far end.

RHC – See "Regional Holding Company."

RING AROUND – The improper routing of a call back through a switching center already involved in attempting to complete the same call.

RING SIGNAL – A signal that activates the bell or buzzer in the telephone set.

RINGBACK SIGNAL – The sound the telephone caller receives

when the called telephone set is ringing.

RINGDOWN – The method of signaling an operator in which telephone ringing current is sent over the line to operate a lamp and the drop of a self-locking relay.

RINGING KEY – The key that sends the ringing current.

RJE – Remote job entry.

RO – Receive-only. A printer terminal with no keyboard for data entry.

ROTARY – A type of telephone dialing via a series of electrical impulses to the central office. (See also "Tone.")

RS-232 – A technical specification published by the Electronic Industries Association that establishes interface requirements between modems, terminals or computers, and communications lines.

SATELLITE COMMUNICATIONS – An orbiting system in space that receives radio signals from ground bases on earth and then retransmits them to distant locations.

SATELLITE PBX – A PBX or Centrex system that is not equipped with attendant positions but is associated with an attended main PBX or Centrex system.

SDLC – Synchronous Data Link Control. An IBM communications line discipline or protocol. By contrast with Bisync, SDLC provides for full-duplex transmission and is more efficient.

SDNs – See "Virtual Private Networks."

SECTIONAL CENTER – A control center connecting primary centers.

SEIZURE SIGNAL – A signal used by the calling end of a trunk or line to indicate a request for service.

SELECTIVE CALLING – The function that allows a calling party to automatically select the station among many stations to receive a call.

SELECTIVE PAGING TO STATION – An originating station is able to page to selective individual station instruments.

SENDER – The device in a switching system that automatically or manually transfers the message to the next part of the system.

SERIAL TRANSMISSION – Normal mode of data communications whereby character bits are transmitted one at a time, instead of in parallel blocks as with internal CPU data transfer.

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SERVER UTILIZATION RATIO – Generally represented by the greek letter rho. A measure of how busy the server will be. Normally, this ratio must be less than one, or the delay will be infinite (when rho is greater than one, the server is not able to keep up with incoming work requests). Defined as rho = lambda/mu, with lambda the average number of customers who arrive per second, and mu the average number of customers served per second.

SERVICE LINE – Generally, an exchange line that extends from various data stations to the telco center with the purpose of monitoring the line for any defects.

SERVING AREA – 1) Region surrounding a broadcasting station where signal strength is at or above a stated minimum. 2) Geographic area handled by a telephone exchange.

SHARED TENANT SERVICES (STS) – Communications system centering around the joint use of a PBX or Centrex service by more than one business tenant in a building or complex.

SHIELDED PAIR – Two wires in a cable wrapped tightly to avoid any interference.

SHORT HAUL – Private line service that extends less than 25 miles.

SIDEBAND – The bands of frequency above and below a carrier frequency which are produced by its modulation.

SIDETONE – The effect of a phone's microphone that allows callers to hear their own voices or room noises through their own handset.

SIGNAL-TO-NOISE RATIO – Relative power of the signal to the noise. As the ratio decreases on a line, it becomes more difficult to distinguish between information and non-information (noise).

SIGNALING – The process by which a dialed number is routed through the telephone network and a connection is made between two stations.

SIMPLEX – A circuit or device that permits transmission in one direction only.

SINGING – An unintended whistle on the transmission circuit.

SINGLE SIDE BAND – See side band.

SINGLE-FREQUENCY SIGNALING – A method of conveying dialing or supervisory signals, or both, with one or more specified single frequencies.

SINGLE-QUEUE, MULTISERVER SYSTEM – A queuing system where all customers wait in a single pool, and then are served by a mechanism consisting of several servers (for example: a bank with a single line and several tellers).

SNA – Systems Network Architecture, developed by IBM.

SOFTWARE-DEFINED NETWORKS – See "Virtual Private Networks."

SOUND-POWERED TELEPHONE – A telephone in which the operating power is derived from the speech input only.

SOURCE POPULATION – The ultimate population of users requesting service. Generally assumed to be infinite, though in reality never so.

SPACE – The signal (communications channel state) corresponding to a binary zero. The spacing condition exists when no current flows (current-loop channel) or when the voltage is more positive than +3 volts (EIA RS-232-C channel).

SPACE-DIVISION SWITCHING (SDS) – Method for switching signals in which each connection through the switch takes a physical separate path.

SPEAKERPHONE – Phone that offers hands-free opportunities.

SPECIAL NIGHT ANSWERING POSITION – A facility which provides either a minimum console or a preassigned single extension station to answer all incoming night calls. Same as NIGHT ANSWER AND SIGNALLING but restricted to certain "special" station instruments so arranged to accommodate this facility.

SPECIALIZED COMMON CARRIER RULING – 1971 FCC decision expanding the scope of its 1969 MCI Decision. The 1971 decision allowed common carriers to enter the specialized long-distance market nationally, and ordered the Bell operating companies to provide local network access to the independent (non-AT&T) long-distance and data transmission carriers and their customers.

SPECIALIZED CARRIER – A government regulated company that provides interstate communications facilities; the regulation rules are different from those for common carriers.

SPEECH CIRCUIT – Circuit designed for the transmission of speech, either analog or encoded, but which can also be used for data transmission or telegraphy.

SPEECH SCRAMBLER – A device in which speech signals are converted into unintelligible forms before transmission, and

are restored to intelligible forms at reception; used to obtain some measure of privacy against interception by unauthorized persons.

SPEED DIAL – PBX or other equipment feature that allows a user to dial a 7- or 10-digit number by only pressing a few programmed keys.

SPILL FORWARD – The transfer of full control on a call to the succeeding office by sending forward the complete telephone address of the called party.

SPREAD SPECTRUM – A communications technique in which the modulated information is transmitted in a bandwidth considerably greater than the frequency content of the original information.

START BIT – In asynchronous transmission, actually a change in channel state from the quiescent state; it normally persists for one bit time (hence start bit) and signals the beginning of a character.

STATION DIRECT STATION SELECTION – A station user is able to place a call to any one of a given number of preselected station lines within the PBX system by depressing a single pushbutton on his station, or auxiliary pushbutton miniconsole, associated with each station number to be included in this arrangement.

STATION – A location on a network with a specific address which allows the signals from other stations to be routed to it.

STATION CAMP-ON – For station-to-station calling applications and inherent to this feature in the indication of camp-on to the called station.

STATION CALL TRANSFER – A station user can transfer incoming central office calls to another station within the system without the need for attendant assistance.

STATION BUSY OVERRIDE – Indicates that preselected stations have the facility to "pre-empt" busy circuits and override a private conversation.

STATION BUSY LAMPS – Individual lamps are located on the station instrument, providing a visual indication of each station in the system which is busy on an internal call.

STATION RESTRICTION FROM TRUNKS – Preselected stations within the system are denied the ability to gain access to outgoing central office trunk circuits.

STATION REPERTORY DIALING – Provides either pushbutton selection to a station which, when depressed, automatically dials a preprogrammed number.

STATION OVERRIDE SECURITY – On an individual station line basis, such designated stations can be "shielded" against the EXECUTIVE BUSY OVERRIDE facility being used by another station.

STATION MONITORING – Allows selected stations to monitor any other stations within the system.

STATION MESSAGE DETAIL RECORDING (SMDR) – Service that records all pertinent data for each call made. The record includes called number, starting time, and originating station, among other listings.

STATION HUNTING CONSECUTIVE (BUSY HUNT) – When stations are arranged in consecutively numbered "groups", and this facility is provided, an incoming call to any of those stations within the group, if busy, will progressively "search" through the remaining stations within that group and will establish connection to the first available (non-busy) station.

STATION FORCED BUSY – A facility which allows a station user, upon dialing a special code, to "busy out" his station for temporary periods of time when he does not wish to be disturbed.

STATION TOUCHDOWN TO ROTARY DIAL CONVERSION – Indicates that a system may be fully TOUCHTONE internally, and conversation is made by the central equipment to rotary dial outpulsing on outgoing central office calls.

STATION TOOL RESTRICTION – The ability of the system to deny the passage of "Area Codes".

STATION TONE RINGING – An electronic tone ringer or a small loudspeaker which transmits an oscillator-created tone.

STATION VISUAL SIGNALING – Found on station instruments, a lamp is provided which indicates flashing incoming, steady

busy and "wink" hold visual conditions associated with that station.

STATION TRANSFER SECURITY – If a trunk call is transferred from one station to another, and the second station does not answer within a predetermined time interval, the trunk call will be automatically rerouted to the attendant console.

STATION-TO-STATION CALLING – Direct dialing between stations without attendant intervention.

STATUS INFORMATION – Information concerning the logical status of a piece of equipment.

STEP-BY-STEP SWITCHING – The first type of automatic switching to be used in a central office. (See also "Progressive, Direct Control.")

STOP BIT – In asynchronous transmission actually the quiescent state following the transmissions of a character; usually required to be 1, 1.42, 1.5, or 2 bit times long, minimum.

STORE AND FORWARD – A mechanism that allows messages to be stored at some point in a network when a complete transmission path to the receiving terminal is not available and then retransmits them when a transmission line becomes free.

STORE AND FORWARD – A characteristic of message and packet switching.

STRAP – A quixotic piece of jargon that means wired connection. A strapping option, then, means one that is implemented by changing wires.

STS – See "Shared Tenant Services."

STUNT BOX – Originally an electromechanical device for performing communications control functions for a network of Teletype teletypewriters. Like everything else, it's going electronic.

SUB-VOICE GRADE LEVEL – A channel with a bandwidth less than one voice grade level.

SUBCARRIER – A carrier that is applied as modulation on another carrier or on an intermediate subcarrier.

SUBSCRIBER NUMBER – Part of the national numbering plan, the subscriber number is the last four digits of a telephone number.

SUBSCRIBER LOOP – Direct connection between a subscriber and the central office.

SUBSET – Synonym for modem.

SUPERGROUP – A group of 60 voice channels, composed of five 12-channel groups.

SUPERVISED STATION RELEASE – Any station which remains "off-hook" without dialing or remains connected to a busy station (and receiving busy signal) for more than a predetermined time interval, is automatically routed to the attendant console.

SUPERVISION – The monitoring of the progress of a call.

SUSCEPTIVENESS – The tendency of circuits to pick up noise and low frequency induction from power systems. It depends on telephone circuit balance, transpositions, wiring spacing, and isolation from ground.

SWITCH – A piece of equipment that establishes and routes communication paths between separate extensions.

SWITCHED MESSAGE NETWORK – A common carrier network service providing interconnection of message devices (teletypewriter). Examples of Telex and TWX.

SWITCHED LINE – One of a series of lines that can be interconnected through a switching center. Often used to refer to the public telephone network.

SYNC CHARACTER – A character of defined bit pattern that is used by the receiving terminal to adjust its clock and achieve synchronization.

SYNCHRONIZATION – Process of adjusting a receiving terminal's clock to match the transmitting terminal's clock.

SYNCHRONOUS – In step. A form of transmission that uses no redundant information (such as the start and stop bits in asynchronous transmission) to identify the beginnings and ends of characters. The timing base is supplied by sync characters transmitted prior to data; usually, synchronization can be achieved in two or three character times.

T-CARRIER or T1 CIRCUIT – Specialized circuit developed in the 1960s for the transmission of

digital signals over the telephone network. These circuits transmit approximately 1.5 million bps and can carry up to 24 voice channels.

T2 – An AT&T term for a digital carrier facility used to transmit a DS-2 formatted digital signal at 6.312M bps.

T3 – An AT&T term for a digital carrier facility used to transmit a DS-3 formatted digital signal at 44.736M bps and above.

TAIL CIRCUIT – The leased or privately owned communication line linking the end of a major transmission link, such as a microwave or satellite link or LAN, to the end user location.

TALKING BATTERY – The voltage sent by the central office to the subscriber in order to activate the carbon transmitter in the handset.

TALKING PATH – The connection in a telephone circuit between the tip and ring conductors.

TANDEM TRUNKING – This facility allows trunk-to-trunk connections through the switching system, without the need for any attendant assistance or control.

TARIFF – Published service offerings and rate schedule by a common or specialized carrier. The FCC or local PUC has this prerogative of not approving a proposed tariff. If not disapproved the proposed tariff. If not disapproved the proposed tariff goes into effect. The FCC/PUC can second question themselves later and render disapproval after the tariff goes into effect.

TCAM – Telecommunications Access Method. This is an IBM macro language for creating communications message control and applications programs.

TDM – Time division multiplexing.

TDS – See "Time-Division Switching."

TELECOMMUNICATIONS – Any communication process that allows the transmission of information from a sender to a receiver by means of an electromagnetic or lightwave medium.

TELECONFERENCE – A meeting where two or more parties communicate from different locations through the telephone system or other transmission medium.

TELEGRAM – A hard copy message delivered through the general telegraph service to an addressee.

TELEGRAPH CHANNEL – Apparatus and transmission path used for the sending and receiving of telegraph signals.

TELEMETRY – Collection of data at or control over a remote environment in realtime.

TELEPHONE SET – A telephone station instrument.

TELEPHONE FREQUENCY – Frequency between 300 and 3000 Hz where audible voice quality is at a reasonable level for general telephony.

TELEPHONE – A piece of equipment used for the general transmission of voice communications.

TELEPHONE EXCHANGE – A central office.

TELEPHONY – System of speech telecommunications.

TELEPROCESSING – Information system where computer data is processed at a distance from the source via telecommunications.

TELERENT DECISION – 1974 FCC decision overruling the North Carolina Utilities Commission 1973 proclamation that privately manufactured telephone equipment (non-AT&T) could not be attached to the public telephone network except when used solely for interstate calls.

TELETEX – Service enabling document correspondence on an automatic memory-to-memory basis over telecommunications networks. Intended to be complementary to, and to interwork with, telex and data communications services. Information is transmitted in page format to be either displayed on a video display unit (VDU) or used to produce hard copy.

TELETEXT – Generically, one-way transmission designed for widespread broadcasting of graphics and textual information, for display on subscriber televisions or low-cost terminals.

TELETYPE – Trademark of the Teletype Corporation. It is used loosely, over Teletype's objections, as a generic name for keyboard/printers.

TELEX – A form of electronic mail that allows users to type messages on a teletypewriter and send them to a remote printer over the public telephone network.

TELPAK – A service offered by common carriers for leasing wideband channels between two or more points. It is most commonly used for large scale voice communications.

TEMPORARY STATION DISCONNECTION – Allows the attendant to completely remove selected stations from total service at any time on a temporary basis.

TERMINAL BLOCK – A key telephone system panel with metal clips used to connect incoming CO lines and cables to individual telephone sets, accessory equipment, and to the KSU.

TERMINAL – The device used to receive or transmit data through a communications system.

TERMINALS TO LONG DISTANCE OPERATOR – Commonly known as "toll terminals", this facility provides special trunks directly to the long distance telephone company operators. Upon completion of long distance calls by stations, the toll operator will ring the attendant to provide "time and charges".

TEST CENTER – Central facility that controls telephone maintenance as well as performing standard control.

THREE-WAY CALLING – A switching system feature permitting a user to add a third party line without the assistance of an attendant.

THROUGHPUT – The aggregate usable data generated during a specified time period.

TIE-LINE – A private line that connects two PBXs at distant locations.

TIME OUT – A set time period for waiting before a terminal/system performs some action. Typical uses include poll release (assumes terminal cannot transmit further or there is a line problem of some sort). It is the most convenient control technique to prevent difficulties with one terminal in a network from bringing the whole net to a stop.

TIME-DIVISION MULTIPLEXING – A method of combining several communications channels into a single circuit by dividing the transmission path into a number of discrete time slots and assigning each channel its own intermittently repeated slot.

TIME-DIVISION SWITCHING (TDS) – Switching method for time-division multiplexing (TDM) signal which requires shifting from one slot to another in the TDM frame.

TIME-SHARING – Sharing the processing time of a single computer facility (can be multiple processors) among multiple simultaneous users. Time-sharing grew popular as a commercial service. The techniques developed have contributed significantly to advancing the utility of computers in general.

TIP AND RING – A pair of wires that provide the electrical connection between the telephone set and the local central office.

TOLL CENTER – The central toll switching office.

TOLL CALL – Calls outside the local exchange area.

TOLL RESTRICTION--PBX – This facility recognizes either "0" or "1" as the first digit dialed to the central office and denies call completion to the outside trunk.

TOLL RESTRICTION--CENTRAL OFFICE 196 This is an "ordered" feature of the central office trunks obtained from the telephone company. The trunk circuits in the central office are arranged to deny and restrict all tolls calls placed through those circuits.

TOLL SWITCHING TRUNK – A trunk connecting one or more end offices to a toll center as the first stage of concentration for intertoll traffic.

TONE RINGING – Either a steady or oscillating electronic tone is provided at the station instrument to provide incoming call audible signaling.

TONE – A type of telephone dialing that sends to the central office a unique acoustic sound for each number pressed on the dial pad. (See also "Rotary.")

TORN TAPE MESSAGE SWITCHING SYSTEM – Early message switching system (still in use in some parts), whose name was derived from the mode of operations. The center received messages on punched tape. The strips were torn from the punch, carried over to the appropriate transmitting reader, and forwarded to the destination. Queuing was accomplished simply by handing

the strips on pegs by the transmitting terminals. Destinations were read from the tape by interpreting directly on the tape. Chad tape (holes not completely punched) minimized interference between punching and reading.

TOUCH TONE – AT&T's registered trademark for push-button (DTMF) dialing.

TRAFFIC CAPACITY – The maximum traffic per unit of time that a telecommunications system, subsystem, or device can carry under specified conditions.

TRAFFIC INTENSITY RATIO – A coefficient defined as the ratio of the arrival distribution variance to the square of the mean interarrival time.

TRAFFIC – The volume and intensity of transmitted signals on a communications channel.

TRANSCEIVER – Terminal that transmits and receives traffic.

TRANSDUCER – Apparatus that converts signal form.

TRANSFER ALL CALLS – This facility allows the station to make one transfer of an outside line to another internal station.

TRANSLATOR – A telecommunications device that forms call routing information from dialed digital signals.

TRANSMISSION – The sending and receiving of telecommunications message through appropriate channels.

TRANSPARENCY – Mode in which control characters recognition is "suspended" allowing any bit pattern to be transmitted without unexpected results. Useful for transmitting non-alphanumeric data, such as program code, non-standard codes, etc. Actually, the rules for control code recognition are changed and the number of control codes that are recognized is usually limited (sometimes to just Escape). Otherwise, once in transparency mode, these would be no out.

TRUNK CARDS – Integrated circuit boards that provide physical termination points for outside trunks.

TRUNK ANSWER FROM ANY STATION – A night service facility activated by the attendant, whereby incoming calls, normally directed to the attendant, activate a common alerting system (bells, gongs, etc.) on the customer's premises and these calls can be answered by dialing a special single digit from non-restricted stations.

TRUNK – A communications channel linking a central office with a PBX or other switching equipment.

TRUNK GROUP – The arrangement of similar types of trunk circuits into an indentifiable group.

TRUNK, TANDEM TIE – A series of dial access/dial repeating tie trunks interconnecting PBXs.

TRUNK-TO-TIE TRUNK CONNECTIONS – The ability of the switching system to provide the attendant with the capability of extending an incoming central office trunk call to a Tie Trunk which terminates within the system.

TRUNK-TO-TRUNK CONSULTATION – Allows a station connected to an outside trunk circuit to gain access to a second outside trunk circuit for "outside" consultation; however, no conference capability is available with this feature.

TRUNK-TO-TRUNK CONNECTIONS ATTENDANT – Provides attendant capability to make all types of trunk connections.

TRUNK-TO-TRUNK CONNECTIONS STATION – A station already in connection with either an incoming or outgoing trunk is able to utilize the CONSULTATION HOLD and ADD-ON CONFERENCE circuitry to effect a conference with another circuit or with another trunk.

TRUNKAGE FACTOR – The ratio of trunks (or outside lines) to extensions (or telephone sets) within a given telephone system.

TRUNKS-DIRECT TERMINATION – Each incoming or combination trunk appears on a key at a console or at a jack position on a cord switchboard and the attendant is always in full visual supervision of the status of all such circuits.

TSO – Time-sharing Option. IBM programming system, running under the main operating system, for implementing time-sharing.

TTY – Abbreviation for Teletype equipment.

TURNAROUND TIME – On a half-duplex circuit, the actual time that it takes to reverse the direction of a transmission.

TWISTED-PAIR CABLE – Telephone transmitting lines made of two insulated copper wires twisted together. Twisted-pair cable is almost universally used in local loop and intra-building wiring.

TWO-PARTY STATION SERVICE – A PBX system with two internal stations and with selective ringing to each.

TWO-WAY SPLITTING – The attendant is able to consult privately with either party (internal or external) on a calling appearing on her position.

TWO-WIRE CHANNEL – Half-duplex transmission facility, characterized by a single wire pair.

TWX – Western Union switched teleprinter exchange service. Extensive interconnection is provided with the speed and code incompatible Telex network through Western Union's computers.

UDLC – Universal Data Link Control, a bit oriented protocol developed by Sperry Univac.

UNATTENDED OPERATION – Transmission and/or reception without an operator.

UNBALANCED LINE – A transmission line in which the magnitudes of the voltages on the two conductors are not equal with respect to ground; e.g., coaxial cable.

UNIFORM CALL DISTRIBUTION (UCD) – Allows calls coming in on a group of lines to be assigned stations as smoothly as possible so that all stations can handle similar loads. Most call distribution systems also provide for a queuing of incoming calls with the longest holding time presented for service first.

UNIFORM NUMBERING PLAN – Permits station users at a PBX to place calls over tie trunks using a uniform dialing plan.

UNINTELLIGIBLE CROSS TALK – See "cross talk."

UNSUCCESSFUL CALL – A call attempt that does not result in the establishment of a connection.

UPLINK – Transmission between an earth station and an orbiting satellite.

USACII – See ASCII. The name change was a result of the name change of the standards organization. When the name changed again to ASNI, most people simply reverted to ASCII.

USAGE CHARGE – Tariffed amount of payment due for actual usage of a communications service, generally based on timed facilities usage.

USER – Subscriber who partakes of a particular telecommunications procedure or service.

VACANT CODE INTERCEPT – Routes all calls made to an unassigned "level" (first digit dialed) to the attendant or to a busy or "reorder" signal, or to a recorded announcement.

VACANT NUMBER INTERCEPT – Usually routes all calls to unassigned numbers to the attendant or to a busy signal, or to a precorded announcement.

VACs – See "Value-added Carriers."

VALUE-ADDED CARRIERS (VACs) – Providers of special data transmission services over leased lines.

VANs – See "Value-added Networks."

VENDOR – Seller of telecommunications services or equipment.

VIA NET LOSS – The net losses of trunks in the North American long-distance switched network.

VIDEOTEX – A communication service in which a user can access a remote database and

receive the requested data on the user's video display.

VIRTUAL CALL – A call, established over a network, that utilizes the capabilities of either a real or virtual circuit by sharing all or any part of the resources of the circuit for the duration of the call.

VIRTUAL PRIVATE NETWORKS (VPNs) – Through the use of sophisticated, computer-controlled switching functions, these systems provide the functions and features of a private network without the need for dedicated private lines. Also called Software-defined Networks (SDNs).

VOCODER – An early type of voice coder, consisting of a speech analyzer and a speech synthesizer, used to reduce the bandwidth requirement of speech signals.

VOICE PAGING ACCESS – Allows attendants and station users the ability to have dial access to customer-provided loudspeaker paging equipment.

VOICE GRADE CHANNEL – Nominally a channel with bandwidth equivalent to a telephone channel obtained through the public telephone network; the bandwidth is usually specified as 3000 to 4000 Hz. Voice channels are usually spaced in transmission facility 4000 Hz apart, but not all of that bandwidth is really due to "guard bands", which reduce crosstalk. The telephone network itself is usually defined in terms of channels with a response from 300 Hz to 3000 Hz.

VOICE-MAIL – Sophisticated telephone voice messages that are recorded and translated into digital bits for storage and manipulation. Voice-mail systems use specialized hardware and software and can be incorporated into a PBX or used as stand-alone systems.

VOICE-OPERATED RELAY CIRCUIT (VOX) – A circuit that permits the equivalent of push-to-talk operation of a transmitter by the operator.

VPN – See "Virtual Private Networks."

VRC – Vertical redundancy check; character parity.

VTAM – Virtual Telecommunications Access Method. IBM communications I/O control programming. It offers many advances over previous IBM techniques, such as BTAM and TCAM, but has not replaced these methods.

WAIVERS – Term commonly used to refer to requests made by the BOCs and AT&T for modifications to the Computer II and MFJ plans.

WAVEGUIDES – Hollow tubes that confine and guide ratio transmission waves between two locations. See "Microwave."

WAY STATION – One of the stations on a multipoint channel.

WESTERN ELECTRIC – AT&T's pre-divestiture division responsible for the manufacture of telephone, switching, and transmission equipment. Renamed AT&T Technologies after the MFJ took effect in 1984.

WHITE NOISE – Interference that is caused by the abnormal electrical movement in circuits.

WHITE NOISE – A signal whose energy is uniformly distributed among all frequencies within a band of interest. Seldom occurring in nature, white noise is a useful tool for theoretical research.

WIDE AREA TELECOMMUNICATIONS SERVICE (WATS) – A discount subscriber service which permits customers, by use of an access line, to make calls in and to specified U.S. geographic zones (outward WATS) or to receive incoming calls at a specified number (inward WATS) at reduced costs.

WIDEBAND – A communications channel with a bandwidth wider than a voice grade channel, usually at 56K bits per second or greater.

WINK PULSING – Recurring pulses of a type where the off-pulse is very short with respect to the on-pulse.

WORD PROCESSORS, COMMUNICATING – Personal computers with word processing functions and the ability to send and receive digital messages directly from other compatible microcomputers.

WORD – As used in message traffic, a word consists of five information characters and one space. This results in a simple conversion from words per minute (wpm) to characters per second; divide by 10. If the code structure is 10 bits per character, which is common among typewriter terminals, wpm and bps are numerically equivalent.

WORLD NUMBERING PLAN – CCITT numbering plan that divides the world into nine zones. Each zone is allocated a number that forms the first digit of the country code for every country in that zone.

X.25 – A protocol developed by CCITT, the standards writing organization for international telephone carriers, for packet switching procedures.

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